North Carolina Department of Transportation
Statewide Planning Branch
Small Urban Planning Unit

Thoroughfare Plan for Watauga County

July 2002

Watauga County Thoroughfare Plan

Prepared by the:

Statewide Planning Branch
Division of Highways
North Carolina Department of Transportation

In cooperation with:

Watagua County
The Federal Highway Administration
U.S. Department of Transportation

July 2002

Travis K. Marshall, P.E.
Small Urban Planning Unit Head

Acknowledgments

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Executive Summary

This plan documents the findings of a thoroughfare plan study for Watauga County. Below is a listing and brief description of these findings. A more detailed discussion of these recommendations can be found in Chapter 2.

Principal Arterials

- US 421: four-lane divided facility on new location from NC 194 to 2 miles east of US 221 for 11.9 miles (R-529).
- NC 105: widen roadway to a multi-lane facility from western Boone Urban Planning Boundary (BUPB) to the Avery County Line (R-2566).
- US 321 (South of Boone): widen roadway to a four-lane facility from just north of US 221 interchange to the Caldwell County Line (R-2237).
- US 321 (West of Boone): widen from two 10-foot lanes to two 12-foot lanes from Cove Creek Bridge to Avery County Line.

Minor Arterials

- US 421 (North of Boone): widen roadway to a multi-lane facility from US 321 in Boone to the Tennessee State Line (R-2615).
- US 221: widen roadway to a four-lane divided facility from US 421 to the Ashe County Line (R-2915).

Major Collectors

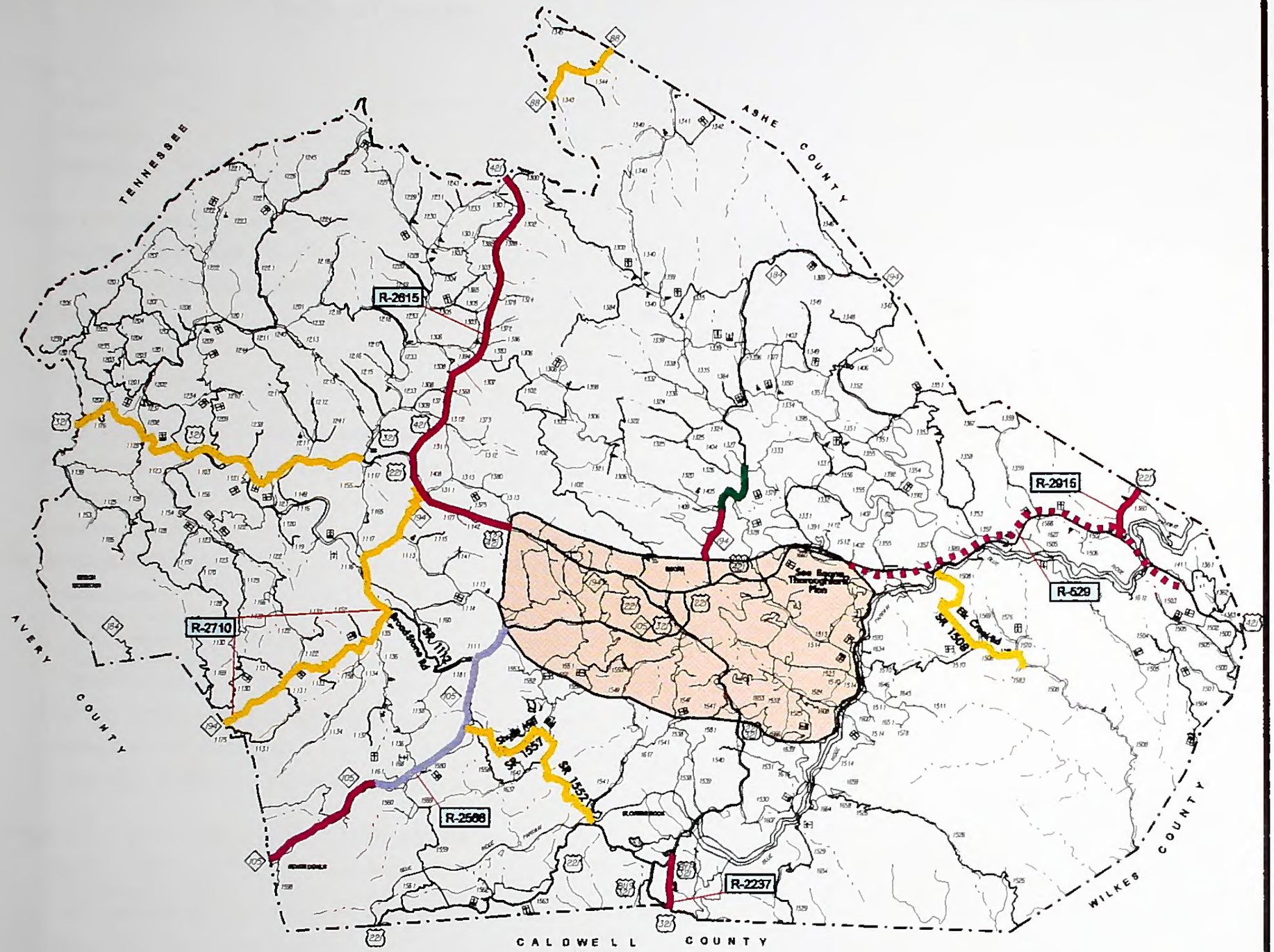
- NC 194 (North of Boone): widen roadway to a four-lane divided facility from US 421 to SR 1306 (Howards Creek Road). It is also recommended to widen the facility from SR 1306 to SR 1327 (Jack Hayes Road) to a three-lane facility.
- NC 194 (South of Boone): widen existing 9 or 10-foot lanes to 10 and11-foot lanes from US 421 to Avery County Line.
- NC 88: widen from two 9-foot lanes to two 10-foot lanes from Ashe County Line to Tennessee State Line.

Minor Collectors

- SR 1557/ 1552 (Shulls Mill Road): improve from 8 and 10-foot lanes to 11-foot lanes from SR 1568 (Old Shulls Mill Road) to US 221.

- SR 1112 (Broadstone Road): Install a right turning lane in front of the Valle Crucis Elementary School.

- SR 1508 (Elk Creek Road): improve from 9-foot lanes to 11-foot lanes from SR 1583 (Wes Randall Road) to US 421.



RECOMMENDATIONS

LEGEND

	WIDENING	PROPOSED
3 LANES		
4 LANES		
5 LANES		
PAVEMENT TO 24'		

TIP PROJECT NUMBER — R-0000

URBAN PLANNING BOUNDARY

N

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WATAUGA COUNTY
NORTH CAROLINA

PREPARED BY THE

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
U.S.DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 1 2 3 4 Miles

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Chapter 1
Introduction

Overview

Officials of Watauga County, prompted by a desire to adequately plan for future transportation needs, requested the North Carolina Department of Transportation's (NCDOT) assistance in conducting a thoroughfare plan study. The County Commissioners' primary concern was balancing the need to provide adequate transportation infrastructure, while also minimizing impacts to the County's natural resources. A thoroughfare plan study was requested to determine the impact of this development on the existing transportation system.

The objective of thoroughfare planning is to enable a transportation system to be progressively developed to adequately meet the transportation needs of a community, or region, as land develops and traffic volumes increase. It is essential to plan now for future transportation needs in order to avoid unnecessary costs to the physical, social, and economic environment. Thoroughfare planning is a tool that can be used by local officials to plan for future transportation needs, while at the same time reducing costs to our environment.

The primary purpose of this report is to present the findings and recommendations of the thoroughfare plan study conducted for Watauga County. The secondary purpose of this report is to document the basic thoroughfare planning principles and procedures used in developing these recommendations. This report can be divided into three parts. The first part of the report, covered in Chapter 1, covers the highlights of the study. Chapters 2 and 3 provide a detailed description of the thoroughfare plan study recommendations and address different methods by which these recommendations can be implemented. The final chapter, Chapter 4, covers study procedures and details findings.

Information that will be especially useful to the practitioners is provided in the Appendices. The principles of thoroughfare planning are covered in Appendix A. A detailed tabulation of all routes on the thoroughfare plan and a graphical representation of typical cross sections can be found in Appendices B and C, respectively. Information related to subdivision ordinances is covered in Appendix D. Appendix E provides a list of resources and contacts for Watauga County. Appendix F addresses the process of requesting Transportation Improvement Program Projects and Appendix G includes the purpose and need for a recommendation that should be reevaluated in the next thoroughfare plan update.

Background

Watauga County is located in the Blue Ridge Mountains of the northwestern section of the State and is bounded by the Tennnessee State Line and the counties of Ashe, Wilkes, Caldwell, and Avery. Watauga County has a total area of 313 square miles. The geographic location for Watauga County is shown in Figure 1.

Watauga is a Native American name often translated as "whispering waters, "land of the beyond", or "beautiful waters". The Town of Boone is the county seat and the home of Appalachian State University. Wataugu County has many diverse economic opportunities. The economy is largely composed of service, retail trade, and government industries. Agriculture, construction, and manufacturing also supplement the economic base.

Land use in the county is primarily a mixture of commercial, public, and industrial, with the majority of commercial development being in and around the county's incorporated municipalities.

The major routes in Watauga County include US 421, US 321, NC 194, NC 105, US 221, and NC 88.

Highlights

Major highlights of the 2002 Watauga County Thoroughfare Plan are outlined below. The Thoroughfare Plan is shown in Figure 2 and the Recommended Improvements are shown in Figure 3. Projects included in the 2002-2008 Transportation Improvement Program (TIP) are shown in parenthesis.

- **US 421 (R-2615)**
  Widen roadway to a multi-lane facility from US 321 in Boone to the Tennessee State Line.

- **NC 105 (R-2566)**
  Widen roadway to a multi-lane facility from western Boone Urban Planning Boundary (BUPB) to the Avery County Line.

- **US 321 (R-2237)**
  Widen roadway to a four-lane facility from just north of US 221 interchange to the Caldwell County Line.

- **US 221 (R-2915)**
  Widen roadway to a four-lane divided facility from US 421 to the Ashe County Line.

- **NC 194 (North)**
  Widen roadway to a four-lane divided facility from US 421 to SR 1306. It is also recommended to widen the facility from SR 1306 to SR 1327 to a three-lane facility.

- **Improve the following to provide safety and capacity:**
  1. US 321 (West)-From two 10-foot lanes to two 12-foot lanes from US 421 to Avery County Line
  2. NC 194 (South)- From 9 or 10-foot lanes to 10 or 11-foot lanes from US 421 to Avery County Line
  3. NC 88- From 9-foot lanes to 10-foot lanes from Ashe County Line to Tennessee State Line
  4. SR 1508 (Elk Creek Rd.)- From 9-foot lanes to 11-foot lanes from SR 1583 (Wes Randall Rd.) to US 421

5. SR 1557/ 1552 (Shulls Mill Rd.)- From 8 and 10-foot lanes to 11-foot lanes from SR 1568 (Old Shulls Mill Rd.) to US 221
6. SR 1112 (Broadstone Rd.)- Install a right turning lane in front of the Valle Crucis Elementary School

The North Carolina Department of Transportation and Watauga County are jointly responsible for the proposed thoroughfare improvements. Cooperation between the State and the County is of primary concern if the recommendations outlined above are to be successfully implemented. All parties have mutually adopted the thoroughfare plan, and it is the responsibility of the County to implement the plan following the guidelines set forth in Chapter 3. This plan was adopted by Watauga County on February 19th, 2002 and by the North Carolina Department of Transportation on May 2, 2002.

It is important to note that the recommended plan is based on anticipated growth of the County as indicated by past trends and future projections. Prior to construction of projects proposed herein, a more detailed study will be required to reconsider development trends and to determine specific locations and design requirements.

GEOGRAPHIC LOCATION FOR WATAUGA COUNTY NORTH CAROLINA

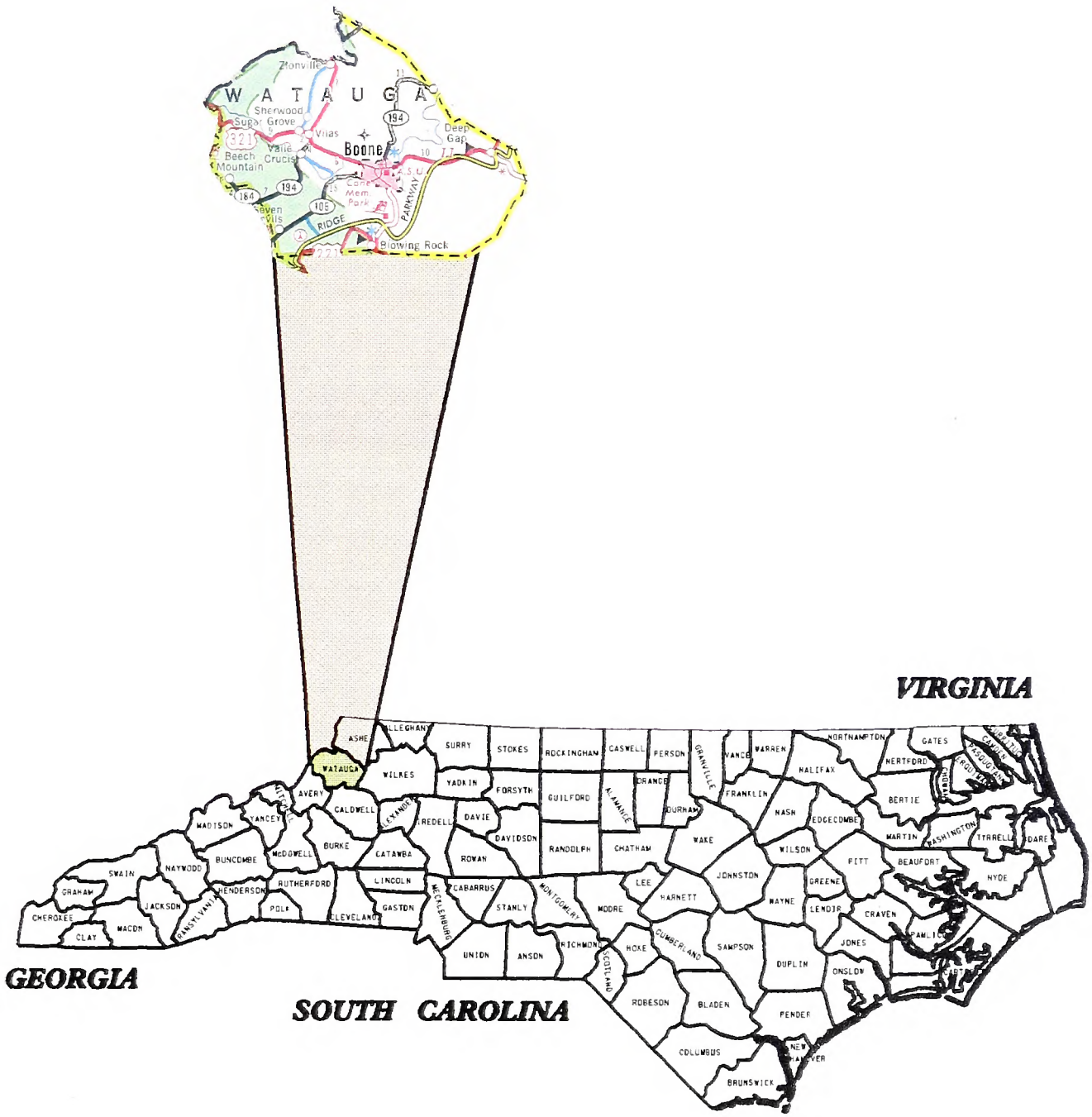

FIGURE 1

Legend

	Existing	Proposed
Interstate		
Principal Arterial		
Minor Arterial		
Major Collector		
Minor Collector		
Grade Seperation	O	
Interchanges	●	
Urban Planning Boundary		

ADOPTED BY:

Watauga County	FEBRUARY 4, 2002
Recommended By: Statewide Planning Branch	APRIL 9, 2002
N.C. Department of Transportation	MAY 2, 2002

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THOROUGHFARE PLAN

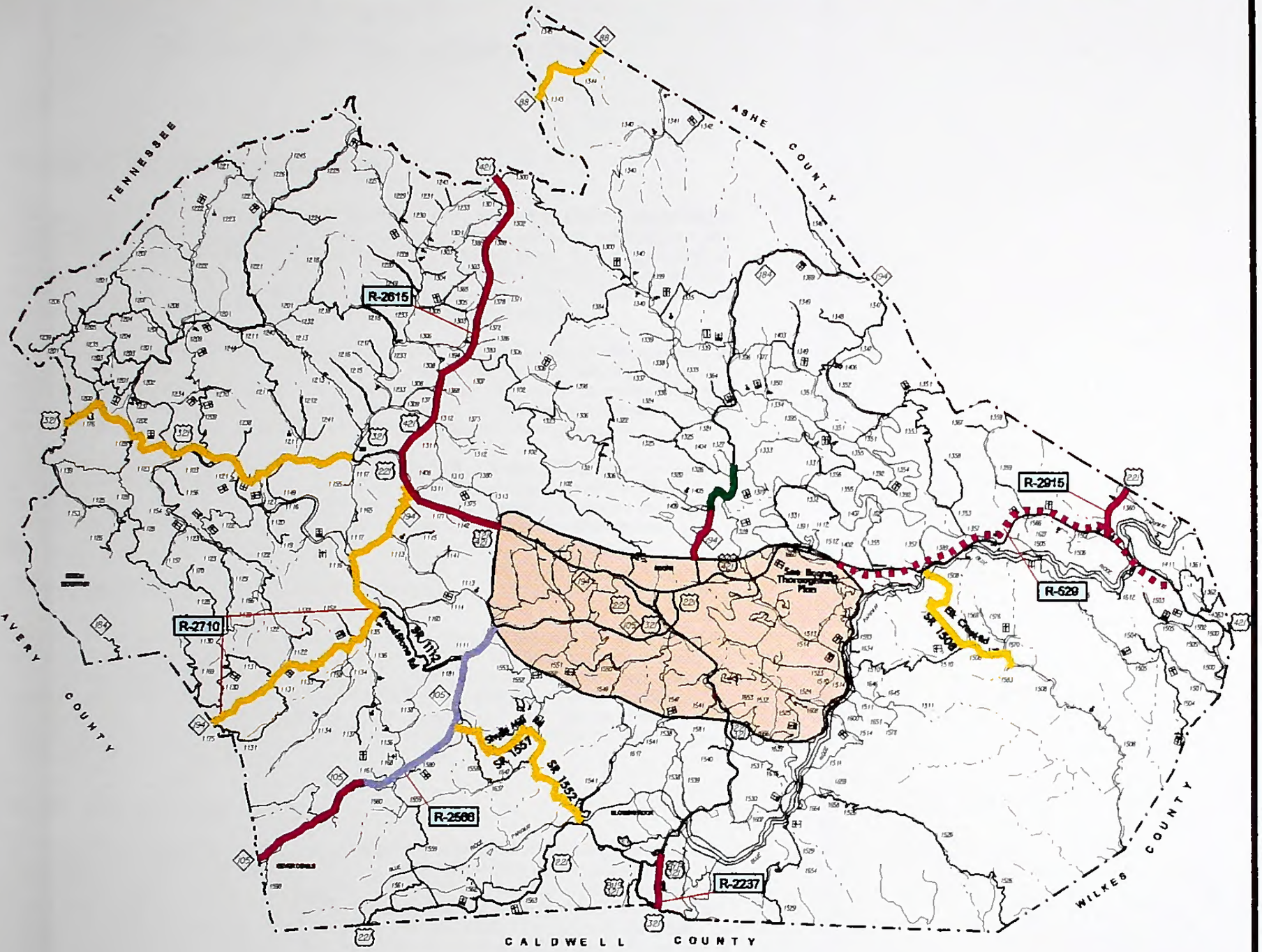
WATAUGA COUNTY
NORTH CAROLINA

PREPARED BY THE

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
U.S.DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 1 2 3 4 Miles

FIGURE 2



RECOMMENDATIONS

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0 1 2 3 4 Miles

FIGURE 3

Chapter 2
Recommended Thoroughfare Plan

Intent of the Thoroughfare Plan

Transportation is the backbone of a region's economic vitality. Without an adequate transportation system people cannot easily reach their intended destination, goods cannot be delivered in a cost effective manner, and investors may look to invest in better served areas. Recent trends such as regional economies, "just in time" delivery, increased automobile ownership, and increased migration away from the central cities and towns are taxing existing transportation systems and requiring that more emphasis be placed on planning for our transportation future.

A thoroughfare plan study identifies existing and future deficiencies in a transportation system, as well as uncovers the need for new facilities. A county thoroughfare plan also provides a representation of the existing highway system by functional use. This use can be characterized as a part of the arterial road system, the collector road system, or the local street system. A full description of these various systems and their subsystems is given in Appendix A.

This chapter presents the thoroughfare plan recommendations. The goal of this study is to propose a transportation system that will serve the anticipated traffic and land development needs of Watauga County. The primary objective of this plan is to reduce traffic congestion and improve safety by eliminating both existing and projected deficiencies in the transportation system.

Thoroughfare Plan Recommendations

The process of developing and evaluating thoroughfare plan recommendations involves many considerations, including the goals and objectives of the area, identified roadway deficiencies, environmental impacts, existing and anticipated land development, and travel services. Chapter 4 contains the documentation of the analysis involved in developing the recommendations for Watauga County. A detailed description of the purpose and need for the recommended improvements that were cooperatively developed are given below. Refer to Figure 3 for a depiction of the recommendations.

US 421 - Purpose and Need

- **Project Recommendation:** It is recommended that a four-lane divided facility be constructed on new location for a project length total of 11.9 miles. The project limits extend from NC 194 to 2 miles east of US 221. This project is included in the 2002 - 2008 Transportation Improvement Program (TIP) as project R-529. Over 70% of the project has been completed, while the remaining is under construction. The estimated cost of the project is $81 million, as reported in the 2002 - 2008 TIP. The approximate project completion date is in the Fall of 2002, however, due to unexpected delays, the date may not be met.

It is also recommended that the section of US 421 between US 321 in Boone and the Tennessee State Line also be widened to multi-lanes. This project is included in the 2002-2008 Transportation Improvement Program as project R-2615 and has a total project length of 13.3 miles. The estimated cost of the project is $71.4 million, as reported in the 2002-2008 TIP.

- **Transportation Demand:** The TIP projects R-529 and R-2615 are both designated as intrastate projects. The Highway Trust Fund Law was established in 1989 with the goal of meeting the State's most critical transportation needs. One of the goals included the completion of the remaining miles of the four-lane construction on the 3,600 mile North Carolina Intrastate System. The portion of the facility running east/ west is functionally classified as a principal arterial, primarily serving statewide and interstate travel. US 421 serves as one of the State's major east / west corridors providing a link between the northwest section and the Piedmont. The route is also a part of the primary east / west corridor for the County. US 421, from the 421 / 321 junction to the Tennessee State Line, is functionally classified as a minor arterial, which primarily joins cities and larger towns and provides intrastate and intercounty service at relatively high overall travel speeds with minimum interference to through traffic.

- **Roadway Capacity and Deficiencies:** The current average daily traffic (ADT) on US 421 ranges from 6,800 to 14,000 vehicles per day (vpd). Over 60% of the US route has existing traffic already exceeding the average capacity of the road, which is approximately 9,000 vpd. The 2030 projected average daily traffic is between 11,000 and 24,000 vpd. US 421 is primarily operating at a level of service (LOS) F. Without any improvements, the level of service by 2030 will deteriorate further as growth continues as expected. The proposed cross section, a four-lane divided facility, will provide capacity of approximately 27,000 vpd and will improve the level of service to C or D.

- **Safety Issues:** Crash data was queried for the period between January 1997 and July 2000. The total crashes along US 421 were 207. The intersection of US 421 with NC 105 is among the highest accident intersections in the County with 51 crashes having been reported. The crashes primarily consisted of rear end, angle, and left turns being made on the same roadway. If no improvements are made to US 421, the resulting increase in congestion will result in the potential for increased accident rates. However, the recommended improvements to US 421 will provide increased capacity, greater maneuverability, and more control of access, resulting in safer driving conditions.

  Most of the development has direct driveway access to US 421, thus reducing the capacity of the facility and creating the potential for increased accident rates. The continuation of this type of access is expected to continue to degrade the ability of the road to carry traffic safely and smoothly. Therefore, it is recommended that access control be implemented to the extent possible.

- **Social Demands and Economic Development:** The economy of Watauga County has shifted from agriculture to a combination of manufacturing, retail, education, and tourism. The County is also home to Appalachian State University who employs several hundred people. An economic boost to Watauga has come from the development of recreational and tourist facilities. The recommended improvements to US 421, in addition to accommodating the expected traffic increase, may also help spur further economic development in this area. Economic development in any portion of the county will increase the tax base, which can be used to improve public services throughout the county, thereby inducing other industries to

locate in the County. Further, the goal of providing a multi-lane, limited access facility to the northwestern part of the State is essential in realizing the full potential of the tourism industry of the County.

- **System Linkage:** Improving US 421 to a four-lane divided facility is part of an objective in North Carolina to provide an adequate intrastate system, as specified in NC General Statute 136-178. This provision by the NC Legislature designates US 421 as an intrastate system highway, designed to "provide high-speed... safe, convenient, through travel for motorists". According to the criteria set forth by this legislation, all intrastate system facilities are proposed to be widened to at least four lanes.

  In addition, US 421 has been designated as part of the National Highway System (NHS), which includes roadways that serve major population centers, intermodal transportation facilities, national defense, and interstate and interregional travel. The NHS comprises only 4 percent of the road network in the nation, but carries over 40 percent of total vehicle miles of travel (vmt) and 70 percent of truck traffic. Further, the portion of US 421 between the Tennessee State Line and the Yadkin-Forsyth County Line is the main highway link between the Piedmont and northwest North Carolina. Because of the significance of US 421 on a statewide and national basis, it is imperative to insure the highway is kept in optimum operating condition.

- **Modal Interrelationships:** Currently, no rail facilities or major airports exist in Watauga County. However, the recommended improvements to US 421 may facilitate passenger vehicle services to the Wilkes County Airport and may also enhance cargo truck service destiny for the rail station. Because of the rural setting of the study area, mass transit service is presently not provided in Watauga County, nor is it planned for in the future.

- **Relationship to Other Plans:** The proposed multi-lane on new location and widening of US 421 is designated as Transportation Improvement Program Projects R-529 and R-2615, respectively. R-2615 is presently designated as an unfunded project. These projects are also reflected in the Thoroughfare Plan for Region D, which was adopted in 1993.

NC 105 - Purpose and Need

- **Project Recommendation:** It is recommended that NC 105 be widened to a multi-lane facility from the western Boone Urban Planning Boundary (BUPB) to the Avery County Line. The total project is approximately 5.3 miles. This project is included in the 2002 - 2008 Transportation Improvement Program (TIP) as project R-2566, but is currently an unfunded project. The estimated cost of this project is $70.0 million, as reported in the 2002 - 2008 TIP. It is recommended to widening NC 105 to five lanes from the BUPB to Overlook Road in Foscoe. However widening to four lanes is recommended for the remainder of the facility to the Avery County Line. It is recommended that partial control of access be implemented for the section widened to four lanes.

- **Transportation Demand:** NC 105 is functionally classified as a principal arterial, primarily serving statewide and interstate travel. The project is also designated as an intrastate project. Widening of this facility will help in reaching the goal to pave the remaining miles of the four-lane construction on the 3,600 mile North Carolina Intrastate System. The route is a north / south corridor used primarily by traffic traveling to resorts in Watauga and Avery County. The resorts include Seven Devils, Beech Mountain, Banner Elk, and Grandfather Mountain.

- **Roadway Capacity and Deficiencies:** The current average daily traffic (ADT) on NC 105 ranges from 10,000 to 19,000 vehicles per day (vpd). The capacity of the existing roadway is approximately 9,000 vpd. The 2030 projected average daily traffic of 18,000 to 33,000 vpd will result in the NC route being over capacity. The facility is currently operating at level of service (LOS) F. Without any improvements, congestion will only worsen by 2030, if traffic growth continues as expected. The proposed cross sections will increase the capacity approximately between 27,000 and 36,000 vpd, thereby improving the level of service.

- **Safety Issues:** Crash data was queried for the period between January 1997 and July 2000. The total crashes along NC 105 were 300. The crashes primarily consisted of rear end, angle, and left turns being made on the same roadway. If no improvements are made to NC 105, the resulting increase in congestion will result in the potential for increased accident rates. However, the recommended improvements to NC 105 will provide increased capacity, greater maneuverability, and more control of access, resulting in safer driving conditions.

  Most of the development has direct driveway access to NC 105, thus reducing the capacity of the facility and creating the potential for increased accident rates. The continuation of this type of access is expected to continue to degrade the ability of the road to carry traffic safely and efficiently. Therefore, it is recommended that access control be implemented to the extent possible.

- **Social Demands and Economic Development:** The economy of Watauga County has shifted from agriculture to a combination of manufacturing, retail, education, and tourism. The County is also home to Appalachian State University who employs several hundred people. An economic boost to Watauga has come from the development of recreational and tourist facilities. The recommended improvements to NC 105, in addition to accommodating the expected traffic increase, may also help spur further economic development in this area. Economic development in any portion of the county will increase the tax base, which can be used to improve public services throughout the county, thereby inducing other industries to locate in the county. Further, the goal of providing a multi-lane, limited access facility to the northwestern part of the State is essential in realizing the full potential of the tourism industry of the County.

- **System Linkage:** Improving NC 105 to a four and five lane facility is part of an objective in North Carolina to provide an adequate intrastate system, as specified in NC General Statute 136-178. This provision by the NC Legislature designates the facility as an intrastate system highway, designed to "provide high-speed... safe, convenient, through travel for motorists". According to the criteria set forth by this legislation, all intrastate system facilities are proposed to be widened to at least four lanes.

  In addition, NC 105 has been designated as part of the National Highway System (NHS), which includes roadways that serve major population centers, intermodal transportation facilities, national defense, and interstate and interregional travel. The NHS comprises only 4 percent of the road network in the nation, but carries over 40 percent of total vehicle miles of travel (vmt) and 70 percent of truck traffic. Furthermore, the NC route serves as a direct link to the tourist attraction locations in southern Watauga County and northern Avery County. Therefore, it is imperative to insure the highway is kept in optimum operating condition.

- **Modal Interrelationships:** Currently, no rail facilities or major airports exist in Watauga County. Because of the rural setting of the study area, mass transit service is presently not provided in Watauga County, nor is it planned for in the future.

- **Relationship to Other Plans:** The widening of NC 105 to a multi-lane facility is currently in the Transportation Improvement Program (TIP) as unfunded project R-2566. The project limits for the project extend from US 221 in Avery County to SR 1107 (105 Bypass) in Boone. This project is also reflected in the Thoroughfare Plan for Region D, which was adopted in 1993.

US 321(South) - Purpose and Need

- **Project Recommendation:** It is recommended that a portion US 321 be widened from two-lanes to four-lanes from just north of Blowing Rock at the Highway 221 interchange to the Caldwell County Line. The entire project extends into Caldwell County to SR 1500 (Blackberry Road). This project is included in the 2002 - 2008 Transportation Improvement Program (TIP) as project R-2237. Currently, part of the project is under construction. The estimated cost of the entire project is $115.7 million, as reported in the 2002 - 2008 TIP. The segment of the project in Watauga County is approximately 2.40 miles. It is recommended that partial control of access be implemented for this section of roadway.

- **Transportation Demand:** US 321 is functionally classified as a principal arterial, primarily serving statewide and interstate travel. The project is also designated as an intrastate project. Widening of this facility is a part of an objective to pave remaining miles of the four-lane highway of the 3,600-mile North Carolina Intrastate System. The route is a north / south corridor used primarily by traffic traveling to tourist attractions or to Caldwell County.

- **Roadway Capacity and Deficiencies:** The current average daily traffic on US 321 is approximately 15,000 vehicles per day (vpd). The capacity of the existing roadway ranges from 9,000 to 27,000 vpd. The average daily traffic is estimated to be 23,000 vpd, which will result in portions of US 321 in Watauga County being over capacity by the year 2030. Portions of US 321 are currently operating at level of service (LOS) E and, without any improvements congestion will worsen, based on traffic growth projections. The proposed cross section, a four-lane divided facility, will provide a capacity of approximately 27,000 vpd and will improve the level of service.

- **Safety Issues:** If no improvements are made to US 321, increasing traffic congestion will result in the potential for increased accident rates. However, the recommended improvements to the facility will provide increased capacity, greater maneuverability, and more control of access, resulting in safer driving conditions.

- **Social Demands and Economic Development:** The economy of Watauga County has shifted from agriculture to a combination of manufacturing, retail, education, and tourism. An economic boost to Watauga has come from the development of recreational and tourist facilities. The recommended improvements to US 321, in addition to accommodating the expected traffic increase, may also help spur further economic development in this area. Economic development in any portion of the County will increase the tax base, which can be used to improve public services throughout the County, thereby inducing other industries to locate in the county.

- **System Linkage:** Improving US 321 to a four-lane facility is part of an objective in North Carolina to provide an adequate intrastate system, as specified in NC General Statute 136-178. This provision by the NC Legislature designates the facility as an intrastate system highway, designed to "provide high-speed... safe, convenient, through travel for motorists". According to the criteria set forth by this legislation, all intrastate system facilities are proposed to be widened to at least four lanes.

  In addition, US 321 has been designated as part of the National Highway System (NHS), which includes roadways that serve major population centers, intermodal transportation facilities, national defense, and interstate and interregional travel. The NHS comprises only 4 percent of the road network in the nation, but carries over 40 percent of total vehicle miles of travel (vmt) and 70 percent of truck traffic. Therefore, it is imperative to insure the highway is kept in optimum operating condition.

- **Relationship to Other Plans:** The widening of US 321 to a multi-lane facility is currently in the Transportation Improvement Program (TIP) under the project R-2237. The project limits for the project do extend into Caldwell County to just north of NC 268. This project is also reflected in the Thoroughfare Plan for Region D, which was adopted in 1993.

US 221- Purpose and Need

- **Project Recommendation:** It is recommended that US 221 be widened to a four-lane divided facility. The project limits for this project are from US 421 to the Ashe County Line, for a total length of 1.2 miles. This project is included in the 2002 - 2008 Transportation Improvement Program (TIP) as project R-2915. The estimated cost of this portion of the project is $5.3 million. It is recommended that partial control of access be implemented for this section of roadway.

- **Transportation Demand:** This US route is functionally classified as a minor arterial, which primarily serves to link cities, large towns, and other major traffic generators. US 221 also serves as an intercounty link, primarily used by vehicles traveling to or from Ashe County.

- **Roadway Capacity and Deficiencies:** The current average daily traffic on US 221 is 6,400 vpd. The capacity of the existing roadway is 9,000 vpd. The projected average daily traffic of 12,400 vpd will result in US 221 being over capacity by the year 2030. The route is currently operating at level of service (LOS) D and, without any improvements, will worsen by the year 2030, based on traffic growth projections. The proposed cross section, a four-lane divided facility, will provide capacity of approximately 27,000 vpd and will improve the level of service.

- **Safety Issues:** Crash data was queried for the period between January 1997 and July 2000. The total crashes along US 221 were 23. The crashes primarily consisted of rear end, angle, and left turns being made on the same roadway. If no improvements are made to US 221, the resulting increase in congestion will result in the potential for increased accident rates. However, the recommended improvements to US 221 will provide increased capacity, greater maneuverability, and more control of access, resulting in safer driving conditions.

- **Social Demands and Economic Development:** The economy of Watauga County has shifted from agriculture to a combination of manufacturing, retail, education, and tourism. An economic boost to Watauga has come from the development of recreational and tourist

facilities. The recommended improvements to US 221, in addition to accommodating the expected traffic increase, may also help spur further economic development in this area. Economic development in any portion of the county will increase the tax base, which can be used to improve public services throughout the county, thereby inducing other industries to locate in the county.

- **System Linkage:** Because of the significance of US 221 in serving intercounty travel, it is important that the highway is kept in good operating condition. Further, US 221 is also the only north / south alternative for vehicles traveling from the eastern part of the county or traveling from the southwestern part of Ashe County.

- **Relationship to Other Plans:** The widening of US 221 to a multi-lane facility is currently in the Transportation Improvement Program (TIP) under the project R-2915. The project limits for the project do extend into Ashe County to the US 221 Bypass just south of West Jefferson. The total cost of this project is estimated to cost $55.2 million, as reported in the 2002-2008 TIP. This project is also reflected in the Thoroughfare Plan for Region D, which was adopted in 1993.

NC 194(North)- Purpose and Need

- **Project Recommendation:** It is recommended that NC 194 be widened to a four-lane divided facility from US 421 to SR 1306 (Howards Creek Road). It is also recommended to widen the facility from SR 1306 to SR 1327 (Jack Hayes Road) to a three-lane road, for a total length of 2.2 miles. It is recommended that partial control of access be implemented for the four-lane section of roadway. NC 194 is designated as a Scenic Byway, which may necessitate additional investigations.

- **Transportation Demand:** The NC route is functionally classified as a major collector, which primarily provide service to most sizable towns not directly served by higher systems. NC 194 serves as a link for intracounty travel.

- **Roadway Capacity and Deficiencies:** The current average daily traffic on NC 194 is between 1,900 and 6,900 vehicles per day (vpd). The capacity of the existing roadway is 9,000 vpd. The projected average daily traffic of 12,000 will result in NC 194 being over capacity by the year 2030. The route is currently operating at level of service (LOS) D and, without any improvements, will worsen to a LOS F by the year 2030, based on traffic growth projections. The proposed cross sections, four-lane divided facility and three-lane facility, will provide capacity between 27,000 and 13,500 vpd and will improve the level of service.

- **Safety Issues:** Crash data was queried for the period between January 1997 and July 2000. The total crashes along NC 194 were 12. The crashes primarily consisted of rear end collisions. If no improvements are made to NC 194, the resulting increase in congestion will result in the potential for increased accident rates. However, the recommended improvements to the facility will provide increased capacity, greater maneuverability, and more control of access, resulting in safer driving conditions.

- **Social Demands and Economic Development:** The economy of Watauga County has shifted from agriculture to a combination of manufacturing, retail, education, and tourism. An economic boost to Watauga has come from the development of recreational and tourist facilities. The recommended improvements to NC 194, in addition to accommodating the

expected traffic increase, may also help spur further economic development in this area. Economic development in any portion of the county will increase the tax base, which can be used to improve public services throughout the county, thereby inducing other industries to locate in the county.

- **System Linkage:** Because of the significance of NC 194 in serving intracounty travel, it is important that the highway is kept in good operating condition. Further, NC 194 is also the only north / south alternative for vehicles traveling from the north central part of the county or traveling from the western part of Ashe County.

- **Relationship to Other Plans:** This project is not directly connected to any other thoroughfare plans.

Widening Projects

The following projects are recommended to be widened to improve safety and capacity. Each of the sections of roadway listed below currently has lane widths less than 12 feet and, based on the volume of traffic on the road and the functional classification, are recommended to be widened. Listed below it has been suggested to widen all substandard roads to the specified feet of pavement according to NCDOT's roadway design. However, smaller widths and/or spot improvements may be used due to mountainous terrain and dangerous curves. Before any roadway improvements are made, especially to roads that are part of the NC Bike Route system, the NCDOT Division of Bicycle and Pedestrian Transportation should be consulted on the most appropriate cross section.

- **US 321(West):** It is recommended that US 321 be widened from two 10-foot lanes to two 12-foot lanes from Cove Creek Bridge to the Avery County Line.

- **NC 194(South):** It is recommended that NC 194 be widened from two 9 and 10-foot lanes to two 10 and 11-foot lanes from US 421 to the Avery County Line. A portion of this project is included in the 2002 - 2008 Transportation Improvement Program (TIP) as project R-2710. The project limit extends from the Avery County Line to SR 1112 (Broadstone Rd.) in Valle Crucis (Watauga County). The estimated cost of the R-2710 is $1.8 million, as reported in the 2002 - 2008 TIP. In the planning and design phases it should also be noted that NC 194 is designated as a Scenic Byway and passes through the Valle Crucis Historic District, which may necessitate additional investigations.

- **NC 88:** It is recommended that NC 88 be widened from the existing two 9-foot to two 10-foot lanes from the Ashe County Line to the Tennessee State Line.

- **SR 1508:** It is recommended that SR 1508 (Elk Creek Road) be widened from two 9-foot lanes to two 11-foot lanes from SR 1583 (Wes Randall Road) to US 421.

- **SR 1557 / 1552:** It is recommended that SR 1557 / SR 1552 (Shulls Mill Road) be widened from two 8 and 10-foot lanes to two 11-foot lanes from SR 1568 (Old Shulls Mill Road) to US 221.

Turning Lane Improvement

The following turning lane is recommended for safety improvements.

It is recommended that a right turning lane be installed in front of the Valle Crusis Elementary School on SR 1112 (Broadstone Rd.). This improvement will provide increased capacity, and greater maneuverability resulting in safer driving conditions.

Bicycle Routes

Watauga County has one designated bicycle route: the Mountain Connector. Because of this designation, the Blue Ridge Parkway facility may be subjected to more bicycle traffic than other facilities of similar design. Due to the shared, or multi-modal, use of this facility, it is recommended that sub-standard sections be widened to a standard cross section for bicycles (Appendix C, cross section O) as funding permits. These improvements will enhance safety and the functional design of the facility. The bicycle routes, described below, are shown in Figure 4.

Mountain Connector

Blue Ridge Parkway: from Wilkes County to Blowing Rock
Blue Ridge Parkway: from Blowing Rock to Watauga County Line

When considering the widening of these facilities, the NCDOT Division of Bicycle and Pedestrian Transportation should be consulted. This division can recommend the most appropriate cross section for the widening, in addition to providing assistance in identifying the need for improvements based on present and future bicycle traffic. For further consideration and assistance, the coordinator of this division can be contacted at the information below.

NC Department of Transportation
Division of Bicycle and Pedestrian Transportation
1552 Mail Service Center
Raleigh, NC 27699-1552
Phone: (919) 733-2804

BICYCLE ROUTE FOR WATAUGA COUNTY

LEGEND

NC BIKE ROUTE 11 MOUNTAIN CONNECTOR

URBAN PLANNING BOUNDARY

N

S

WATAUGA COUNTY
NORTH CAROLINA

PREPARED BY THE

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 1 2 3 4 Miles

FIGURE 4

ITS Deployment Plan

The North Carolina Department of Transportation (NCDOT) is developing a statewide Intelligent Transportation System (ITS) Strategic Deployment plan. The purpose of the plan is to develop a structured implementation of ITS projects by addressing the immediate and long-term transportation needs of the state. The statewide plan is composed of regional plans and Watauga County falls within the Western Region. The Western Region includes Catawba, Cleveland, Burke, Caldwell, Wilkes, Rutherford, Lincoln, Haywood, McDowell, Watauga, Alexander, Jackson, Macon, Transylvania, Ashe, Cherokee, Madison, Polk, Yancey, Avery, Mitchell, Swain, Alleghany, Clay, and Graham Counties.

The ITS Strategic Deployment Plan process identified 62 transportation needs. From the process, it was determined that traveler information, truck safety, and tourist information were the most urgent issues. Short- and long-term project plans were then determined from the needs. The key component of the Western Region ITS Deployment plan is the development of a central database of traveler information to be disseminated to motorists throughout the region.

Short-term projects for the region include the following:

- Integrated Rural ITS Workstation
- Road Weather Information Systems (RWIS)
- Web-based Mapping and Route I.D.
- ATIS Traveler Information Clearinghouse
- Automated Work Zones
- Traveler Information Kiosks at Major Public Venues
- Transit Dispatching, Demand Forecasting, and Automatic Passenger Counting
- Portable Dynamic Message Signs (DMS)
- Enhancements to Broadcast Video and Data
- Internet Traveler Information System
- Truck Safety on Mountain Grades

Long-term projects for the region include the following:

- Traffic Operations Center (Phase II)
- Voice Remote Access System (VRAS)
- Truck Presence Detection
- Weigh-in-Motion (WIM) sites
- Internet Traveler Information System (Phase II)
- Smart Card Payment System
- Web Credentials
- Mobile Inspection

The coordinator for the Mountain Regions and Asheville may be contacted for more information on the Western Region ITS Deployment Plan at the information below.

NC Department of Transportation
Traffic Management Systems
1562 Mail Service Center
Raleigh, NC 27699-1562
Phone: (919) 733-8021

Public Involvement

Based on a request from the Watauga County Board of Commissioners in May of 2000, the study to develop a thoroughfare plan for Watauga County was officially started in October of 2000. NCDOT officials met with the Watauga County Planning Director and Watauga County Planning Board on November 20, 2000. This meeting was held to present information on the thoroughfare planning process and to gather input on the transportation needs of the County. A Public Informational Session was held on August 7th, 2001. The session was well attended with over 70 citizens in attendance. A public hearing was also held on October 15, 2001 with approximately 20 citizens attending. The sessions gave the public the opportunity to comment and ask questions about the proposed recommendations. The proposed thoroughfare maps were also posted in public locations, such as the library, as well as on the County's website.

The proposed thoroughfare plan was presented to the Watauga County Commissioners at the February 19th County Commissioners' meeting, with members of the public present. After a public hearing, the County Commissioners adopted the Watauga County Thoroughfare Plan. The thoroughfare plan was adopted by the North Carolina Board of Transportation May 2, 2002.

Chapter 3
Implementation of the Thoroughfare Plan

Once the thoroughfare plan has been developed and adopted, implementation is one of the most important aspects of the transportation plan. Unless implementation is an integral part of this process, the effort and expense associated with developing the plan will be lost. There are several tools available for use by the County to assist in the implementation of the thoroughfare plan. They are described in detail in this chapter.

State-County Adoption of the Thoroughfare Plan

Watauga County and the North Carolina Department of Transportation (NCDOT) have mutually approved the thoroughfare plan shown in Figure 2. The mutually adopted plan now serves as a guide for the NCDOT in the development of the transportation system for the county. The approval of this plan by the County also enables standard road regulations and land use controls to be used effectively in the implementation of this plan.

Subdivision Controls

Subdivision regulations require every subdivider to submit to the County Planning Board a plan of any proposed subdivision. It also requires that subdivisions be constructed to meet certain standards. Through this process, it is possible to require the subdivision streets to conform to the thoroughfare plan and to reserve or protect necessary right-of-way for proposed roads. The construction of subdivision streets to adequate standards reduces maintenance costs and simplifies the transfer of streets to the State Highway System. Appendix D outlines the recommended subdivision design standards as they pertain to road construction.

Land Use Controls

Land use regulations are an important tool in that they regulate future land development and minimize undesirable development along roadways. The land use regulatory system can improve highway safety by requiring sufficient setbacks to provide for adequate sight distances and by requiring off-street parking.

Development Reviews

The District Engineer's office and the Traffic Engineering Branch of NCDOT review driveway access to any state-maintained road. In addition, any development expected to generate large volumes of traffic (e.g., shopping centers, fast food restaurants, or large industries) should be comprehensively studied by the Traffic Engineering Branch, the Project Development and Environmental Analysis Branch, and/or the Roadway Design Unit of NCDOT. If reviewed at an early stage, it is often possible to significantly improve the development's accessibility while preserving the integrity of the thoroughfare plan.

Funding Sources

County Construction Account

The County Construction Account is used to allocate funding to pave unimproved roads, widen roadways, stabilize dirt roads, make minor alignment improvements, and even construct short connectors when appropriate. These improvements are implemented on a priority basis that is developed through the NCDOT Division Offices. The appropriate Division Engineer's Office should be contacted for more information on the County Construction Account. The office address for Division Eleven, which includes Watauga County, is given below. For more specific contact information for the division office or any other NCDOT personnel, the Customer Service Office can be contacted toll free at 1-877-DOT-4YOU or by visiting the website at www.dot.state.nc.us.

Division Eleven Engineer's Office
N.C. Department of Transportation
P.O. Box 250
North Wilkesboro, NC 28659
(336) 667-9111

Transportation Improvement Program

North Carolina's Transportation Improvement Program (TIP) is a document that lists all major transportation projects, and their funding sources, planned by the NCDOT for a seven-year period. Every two years, when the TIP is updated, completed projects are removed, programmed projects are advanced, and new projects are added. In addition to highway construction and widening, TIP funds are available for bridge replacement, highway safety projects, enhancement projects, environmental mitigation, railroad crossings, bicycle facilities, and public transportation.

During biennial TIP public hearings, municipalities, local citizens groups, and other interested parties request projects to be included in the TIP. The group requesting a particular project(s) should submit to the NCDOT Board of Transportation Member from the county's respective division the following: a letter with a prioritized summary of requested projects, TIP candidate project request forms, and project location maps with a description of each project. Refer to Appendix F for an example of a TIP project request packet. The Board of Transportation reviews all of the project requests from each area of the state. Based on the technical feasibility, need, and available funding, the board decides which projects will be included in the TIP.

Industrial Access Funds

If certain economic conditions are met, Industrial Access Funds are available for construction of access roads for industries that plan to develop property that does not have access to any state-maintained road. The NCDOT Secondary Roads Office should be contacted for information on Industrial Access Funds.

Small Urban Funds

Small Urban Funds are annual discretionary funds that are distributed to municipalities for qualifying projects. A given municipality may receive funding for multiple projects, but there is a maximum of one million dollars per year per division. Requests for Small Urban Fund assistance should be directed to the Division Engineer.

The North Carolina Highway Trust Fund Law

The Highway Trust Fund Law was established in 1989 as a plan with four major goals for North Carolina's roads and highways. These goals are:

1. To complete the 3,600 miles of four lane construction on the North Carolina Intrastate System.

2. To construct a multilane connector in Asheville and portions of multilane loops in Charlotte, Durham, Greensboro, Raleigh, Wilmington, and Winston-Salem.

3. To supplement the secondary roads appropriation in order to pave miles of unpaved secondary roads carrying 50 or more vehicles per day, and all other unpaved secondary roads by 2006.

4. To supplement the Powell Bill Program, which provides funding for improving municipal streets.

5. To widen and improve 113 miles of existing interstate highways.

A portion of this bill, which will benefit Watauga County over the thirty-year planning period, is the paving of most, if not all, of its unpaved roads on the state-maintained system. The Program Development Branch of NCDOT should be contacted for information on the Highway Trust Fund Law.

Implementation Recommendations

The following table gives recommendations for the most suitable funding sources and methods of implementation for the major project proposals of the Watauga County Thoroughfare Plan.

Table 1

Funding Sources and Recommended Methods of Implementation

Projects	Funding Sources				Methods of Implementation			
	Local Funds	TIP Funds	Indust. Access	Small Urban	T-fare Plan	Subdiv. Ord.	Zoning Ord.	Develop. Review
US 421		X			X			X
NC 105		X			X			X
US 321		X			X			X
US 221		X			X			X
NC 194(North)		X			X			X

Construction Priorities and Cost Estimates

Construction priorities will vary depending on what criterion is considered and what weight is attached to the various criteria. Most people agree that improvements to the major thoroughfare system and major traffic routes are more important than minor thoroughfares where traffic volumes are lower. For inclusion in the North Carolina Transportation Improvement Program, a project must show favorable benefits relative to costs and should not be prohibitively disruptive to the environment. For the major project proposals of the Watauga County Thoroughfare Plan, cost estimates have been developed with respect to user benefits. Additionally, probabilities have been estimated for stimulation of economic development and environmental impact.

Offsetting the benefits derived from any project is the cost of construction. A new facility, despite high projected benefits, might prove to be unjustified due to excessive right-of-way and construction costs. Construction costs are estimated by comparison to average statewide construction costs per mile for similar project types. Anticipated right-of-way costs are based on average property costs per acre for the project area. Table 2 gives the breakdown of the total project cost into construction and right-of-way costs for the major project proposals of the Watauga County Thoroughfare Plan as reported in the 2000-2008 Transportation Improvement Program.* The table reflects the cost for the entire project and not just the portion of the project in Watauga County.

Table 2

Project Cost Estimates for Major Projects

Projects	Construction Cost	Right-of-Way Cost	Total Cost
US 421 (R-2615)*	42,500,000	28,900,000	71,400,000
NC 105 (R-2566)*	68,000,000	2,000,000	70,000,000
US 321 (R-2237)*	68,900,000	10,300,000	79,200,000
US 221 (R-2915)*	46,200,000	9,000,000	55,200,000
NC 194 (North)	4,200,000	4,800,000	9,000,000

Reduced user cost should result from any roadway improvement, from simple widening to construction of a new roadway. Roadway improvements should also relieve congested or unsafe conditions. Comparisons of the existing and the proposed facilities are made in terms of vehicle operating costs, travel time costs, and accident costs. These user benefits are computed as total dollar savings, over the thirty-year design period, using data such as project length, base year and design year traffic volumes, traffic speed, type of facility, and volume to capacity ratio.

The impact of a project on economic development potential is shown as the probability that it will stimulate the economic development of an area by providing access to developable land and by reducing transportation costs. This is a subjective estimate based on knowledge of the proposed project, local development characteristics, and land development potential. The probability is rated on a scale from 0 (representing no development potential) to 1.00 (representing excellent development potential).

Environmental impact analysis considers the effect of a project on the physical, social/cultural, and economic environment. Listed below are thirteen items considered when evaluating the impacts on the environment.

- air quality
- water resources
- soils and geology
- wildlife
- vegetation
- neighborhoods
- noise
- educational facilities
- churches
- parks and recreational facilities
- historic sites and landmarks
- public health and safety
- aesthetics

Environmental impact analysis also uses a probability rating from 0 (representing no benefit to the environment) to 1.00 (representing a positive impact to the environment.) Negative values are assigned to probabilities to indicate negative impact. The summation of both positive and negative impact probabilities with respect to these factors provides a measure of the relative environmental impact of a project. Table 3 shows the probability scale used in the analysis. This table can be used as a guideline for interpreting the "Economic Development" and "Environmental Impact" values given in Table 4. Benefit evaluations for US 321 or US 221 are not given due to their funded status in the TIP.

Table 3

Probability Estimation Guide

Subjective Evaluation	Impact Probability
Excellent - very substantial	1.00
Very good - substantial	0.75
Good - considerable	0.50
Fair - some	0.25
Poor - none	0.00

Table 4

Benefits Evaluation for Major Projects

Projects	Cost (millions)	Length (miles)	Economic Development	Environmental Impact
US 421 (North)	71.4	13.3	.50	.25
NC 105	70.0	14.6	.65	.35
NC 194 (North)	9.0	2.2	.25	.35

Chapter 4
Analysis of Watauga County's Roadway System

This chapter presents an analysis of the ability of the existing roadway system to serve the area's travel desires. Emphasis is placed not only on detecting the deficiencies, but also on understanding their cause. Travel deficiencies may be localized and the result of substandard highway design, inadequate pavement width, or intersection controls. Alternately, the underlying problem may be a system deficiency such as a need for a bypass, loop facility, construction of missing links, or additional radials.

Analysis of the roadway system involves examination of the existing travel patterns and identification of existing deficiencies. Roadway capacity and safety analyses are also essential in evaluating the existing transportation system. After a picture of the existing travel conditions has been developed, factors that will impact the future transportation system must be analyzed. These factors include projected population growth, economic development potential, and land use trends. This information is used to determine anticipated future deficiencies in the transportation system.

Current Transportation Plans for Watauga County

Thoroughfare Plans

A thoroughfare plan is a tool to aid officials in the development of an appropriate transportation system. It is important that the communities within a county and county officials cooperate in the development of their transportation system. Thoroughfare plan development and implementation, jointly undertaken, will help ensure the development of an efficient system for travel throughout the county. The following thoroughfare planning studies have previously been done for Watauga County:

1. Boone , plan adopted in 1991
2. Blowing Rock, plan adopted in 1997

Transportation Improvement Program Projects

The Transportation Improvement Program (TIP) is a seven-year project planning document that lists the major transportation improvement projects planned by the North Carolina Department of Transportation (NCDOT). In addition to roadway projects, the TIP includes funding for bridge replacement, highway safety projects, enhancement projects, environmental mitigation, railroad crossings, bicycle facilities, and public transportation. Listed below are projects identified in the 2002 – 2008 TIP for Watauga County.

1. **US 321**

   R-2237: From north of NC 268 to multi-lanes north of Blowing Rock widen to multi-lanes.

   U-3800: Hardin Street. From Rivers Street (U-3406) to US 421-NC 194 widen to five lanes.

2. **US 221**

   R-2915: From US 421 in Watauga County to US 221 bypass south of West Jefferson widen to four lanes divided.

3. **NC 105**

   R-2566*: From US 221 to SR 1107 in Boone widen to a multi-lane facility.

4. **US 421-321**

   R-2615*: From Tennessee State Line to US 321 in Boone widen to multi-lane facility.

5. **NC 194**

   R-2710: From Avery County Line to SR 1112 (Broadstone Rd.) in Valle Crucis. Widen and resurface roadway.

6. **US 421**

   R-529: From NC 194 in Boone to 2 miles east of US 221. Four lane divided facility on new location.

   U-2703*: Proposed bypass south of Boone, part on new location

7. **Blue Ridge Parkway**

   R-4038: Resurface from mile post 290 to mile post 300.

   R-4039*: Resurface from mile post 276 to mile post 292.

   R-529 BD: Reconstruct Blue Ridge Parkway Bridge No. 91P over US 421.

8. **Guardrail Replacement**

   R-2637: Guardrail installation and safety improvements.

   R-4414: National Highway System Guardrail Rehabilitation. Upgrade substandard Guardrail, end treatments, and bridge anchor units (US 52, US 74, US 311, US 321, US 421, NC 49, and NC 105)

9. **Enhancements**

   E-4134: NC 221 (Blowing Rock). Installation of sidewalk and landscaping.

* Project listed in TIP, but no funds have been assigned.

10. Bridge Projects

B-2658: Boone Creek. SR 1547- Replace bridge #10.

B-3062: Cove Creek. SR 1233- Replace bridge #302.

B-3065: South Fork New River SR 1355- Replace bridge #317.

B-3066: Creek. SR 1522- Replace bridge # 49 and #50.

B-3067: Middle Fork Creek. SR 1542- Replace bridge #324.

B-3262: Clarks Creek. SR 1136- Replace bridge #80.

B-3263: Watauga River. SR 1200- Replace bridge #271.

B-3377: Cove Creek. SR 1217- Replace bridge #168

B-3533: Howards Creek. SR 1306- Replace bridge #43.

B-3534: Laurel Creek. SR 1508- Replace bridge #209.

B-3536: Flannery Fork Creek. SR 1549- Replace bridge #12.

B-3709: Creek. SR 1111- Replace bridge #94.

B-3710: Brushy Fork Creek. SR 1117- Replace Bridge #106.

B-3922: Cove Creek. SR 1149- Replace Bridge #316.

B-3923: Howard Creek. SR 1328- Replace bridge #86.

B-3924: Meat Camp Creek. SR 1335- Replace bridge #33 w/culvert.

B-3925: Meat Camp Creek. SR 1340- Replace bridge #35 w/culvert.

B-3926: Meat Camp Creek. SR 1340- Replace bridge #36 w/culvert.

B-3928: South Fork New River. SR 1351- Replace bridge #334.

B-4315: Bairds Creek. NC 194- Replace bridge #62 w/culvert.

B-4316: Creek. SR 1153- Replace bridge #320.

B-4317: Middle Fork Creek. SR 1541-Replace bridge #16.

B-4318: Watauga River. SR1598- Replace bridge #321.

B-4668: Cove Creek. US 321- Replace bridge #29.

B-4670: Creek. SR 1130- Replace bridge #200.

B-4669: Watauga River. SR 1114- Replace bridge #161.

Existing Travel Patterns and Deficiencies

Traffic Demand

For the purposes of a thoroughfare plan study, roads that are functionally classified are principally the ones studied. Appendix A provides an explanation of functional classification and Figure A-2 depicts Watauga County Functional Classification. Travel demand on these facilities is measured in the form of average daily traffic counts. Traffic counts are periodically taken by the NCDOT throughout the state, including several locations in Watauga County. The 2000 average daily traffic (ADT) for Watauga County's functionally classified roads is shown in Figure 6 and listed in Appendix B, Table B-1.

Width and Alignment Deficiencies

NCDOT's roadway design standards establish criteria for minimum pavement widths, dependent on the type of facility, the design speed, and the current and design year ADT. These criteria call for 12-foot lanes for all highways with design speeds greater than 50 miles per hour (mph) and design year ADT greater than 2,000 vehicles per day (vpd). However, roads with lower speeds and ADT are designed with lane widths as narrow as 10 feet. In addition to criteria for designing new facilities, there are standards for minimum tolerable lane widths on existing roads. These minimum tolerable lane widths are summarized below in Table 5.

Table 5

Minimum Tolerable Lane Widths

Average Daily Traffic (vpd)	Principle Arterials (ft)	Minor Arterials (ft)	Collectors (ft)
Over 2000	11	11	11
400 - 2000	-	10	10
100 - 400	-	10	9
Below 100	-	-	9

There are a number of roads in Watauga County that have substandard widths. Due to the substantial cost of upgrading all secondary roads to standard 12-foot lanes, narrower widths may have to be tolerated until sufficient funds are available for improvements. The roads identified as part of the Watauga County's Thoroughfare Plan study that have substandard widths and, based on the volume of traffic on the road, are recommended to be widened are shown in Figure 7 and are listed below.

- US 321(west): From two 10-foot lanes to two 12-foot lanes from Cove Creek Bridge to Avery County Line.
- NC 194(south): From 9 and 10-foot lanes to 10 and 11-foot lanes from US 421 to Avery County Line.
- NC 88: From 9-foot lanes to 10-foot lanes from Ashe County Line to Tennessee State Line.

- SR 1508 (Elk Creek Rd.): from 9-foot lanes to 11-foot lanes from SR 1583 (Wes Randall Rd.) to US 421.
- SR 1557/ 1552 (Shulls Mill Rd.): From 8 and 10-foot lanes to 11-foot lanes from SR 1568 (Old Shulls Mill Rd.) to US 221.

Capacity Analysis of the Existing System

The adequacy of the existing roadway system is evaluated by comparison of traffic volumes to the ability of the roads to move traffic freely at a desirable speed. The ability of a facility to move traffic freely, safely, and efficiently with minimum delay is controlled primarily by the type and spacing of traffic control measures. Thus, the ability of a road to move traffic can be increased by restricting parking and turning movements, using proper signing and signal devices, and by applying other traffic engineering strategies.

Capacity is the maximum number of vehicles which have a "reasonable expectation" of passing over a given section of roadway, during a given time period under prevailing roadway and traffic conditions. Roadway capacities and 2000 average daily traffic for facilities in Watauga County are shown in Figure 6 and listed in Appendix B, Table B-1. Currently, the following facilities in Watauga County are over capacity:

- US 421: From the Blue Ridge Parkway to the eastern Boone Urban Planning Boundary (BUPB) and from the western BUPB to the Tennessee State Line
- NC 105: From the BUPB to the Avery County Line
- US 321(south): From north of US 221 interchange to the Caldwell County Line

The relationship of traffic volumes to the capacity of the road determines the level of service (LOS) provided. Six levels of service have been defined, with letter designations from A to F. LOS A represents the best operating conditions and LOS F represents the worst.

The definitions of levels of service are general and conceptual in nature. Levels of service for interrupted flow, or signalized, facilities vary widely in terms of both the users perception of service quality and the operational variables used to describe them. The 1995 Highway Capacity Manual contains more detailed descriptions of the levels of service as defined for each facility type. The six levels of service, whose definitions follow, are illustrated in Figure 5.

Levels of Service

LOS A

Describes primarily free flow conditions. Motorists experience high levels of physical and psychological comfort. The effects of minor incidents of breakdown are easily absorbed. Even at the maximum density, the average spacing between vehicles is about 528 feet, or 26 car lengths.

LOS B

Represents reasonably free flow conditions. The ability to maneuver within the traffic stream is only slightly restricted. The lowest average spacing between vehicles is about 330 feet, or 18 car lengths.

LOS C

Provides for stable operations, but flows approach the range in which small increases will cause substantial deterioration in service. Freedom to maneuver is noticeably restricted. Minor incidents may still be absorbed, but the local decline in service will be great. Queues may be expected to form behind any significant blockage. Minimum average spacings are in the range of 220 feet, or 11 car lengths.

LOS D

Borders on unstable flow. Density begins to deteriorate somewhat more quickly with increasing flow. Small increases in flow can cause substantial deterioration in service. Freedom to maneuver is severely limited, and drivers experience drastically reduced comfort levels. Minor incidents can be expected to create substantial queuing. At the limit, vehicles are spaced at about 165 feet, or 9 car lengths.

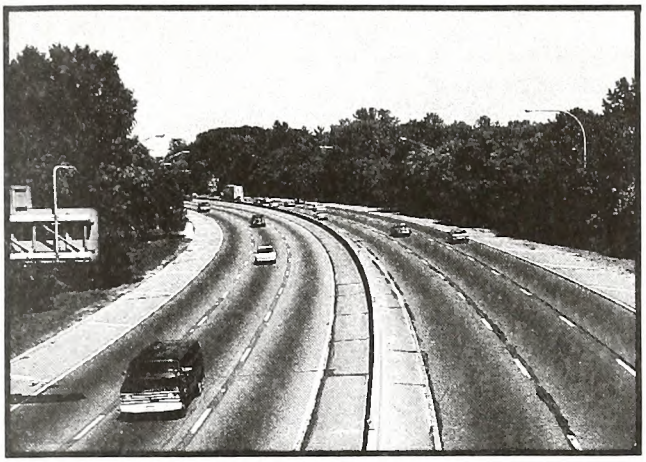
LOS E

Describes operation at capacity. Operations at this level are extremely unstable, because there are virtually no usable gaps in the traffic stream. Any disruption to the traffic stream, such as a vehicle entering from a ramp, or changing lanes, requires the following vehicles to give way to admit the vehicle. This establishes a disruption wave that propagates through the upstream traffic flow. At capacity, the traffic stream has no ability to dissipate any disruption. Any incident can be expected to produce a serious breakdown with extensive queuing. Vehicles are spaced at approximately 6 car lengths, leaving little room to maneuver.

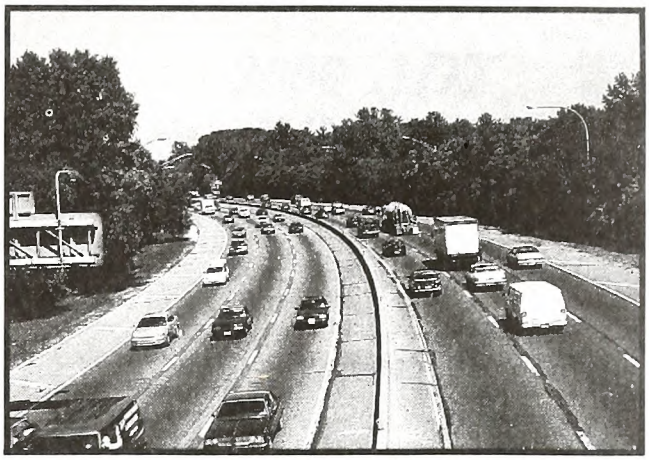
LOS F

Describes forced or breakdown flow. Such conditions generally exist within queues forming behind breakdown points.

Source: 1994 Highway Capacity Manual



LOS A.



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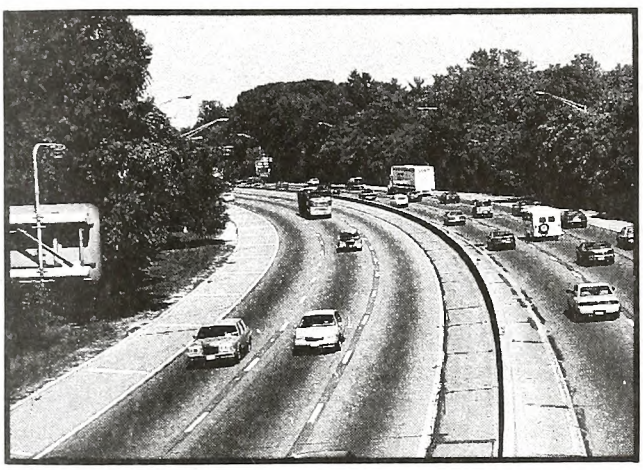
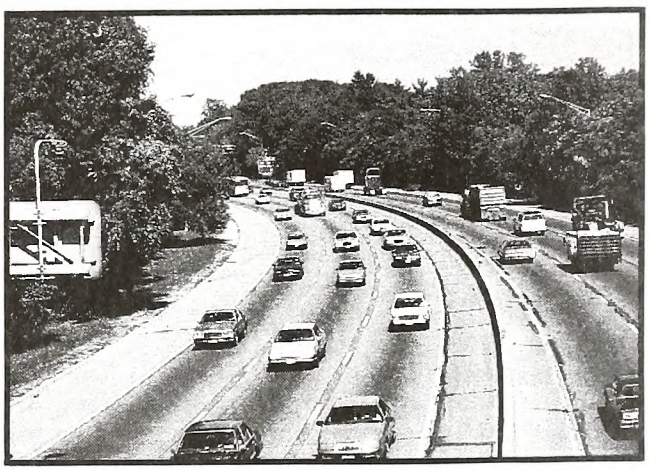
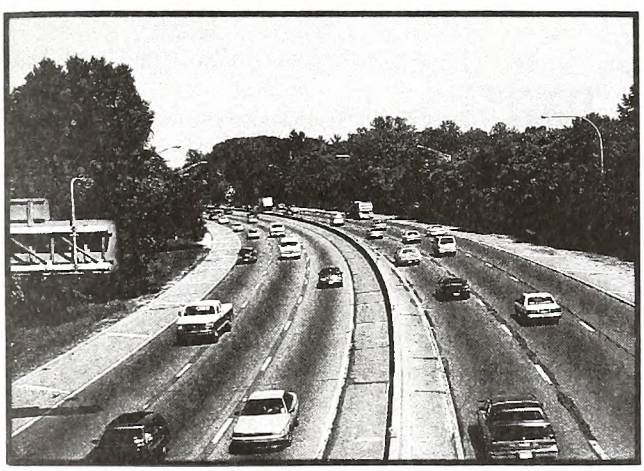


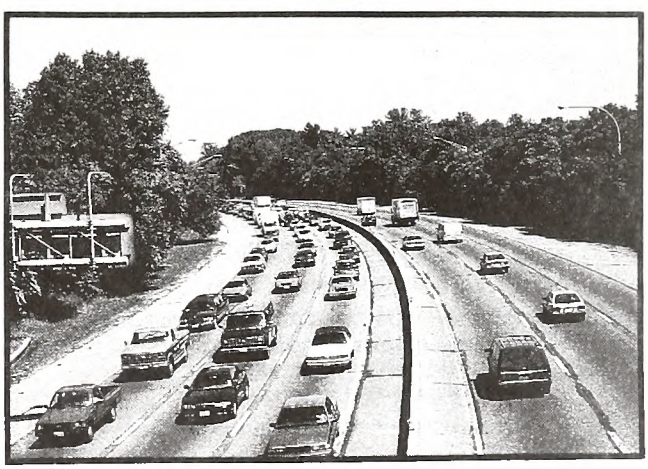
LOS B.



LOS E.



LOS C.

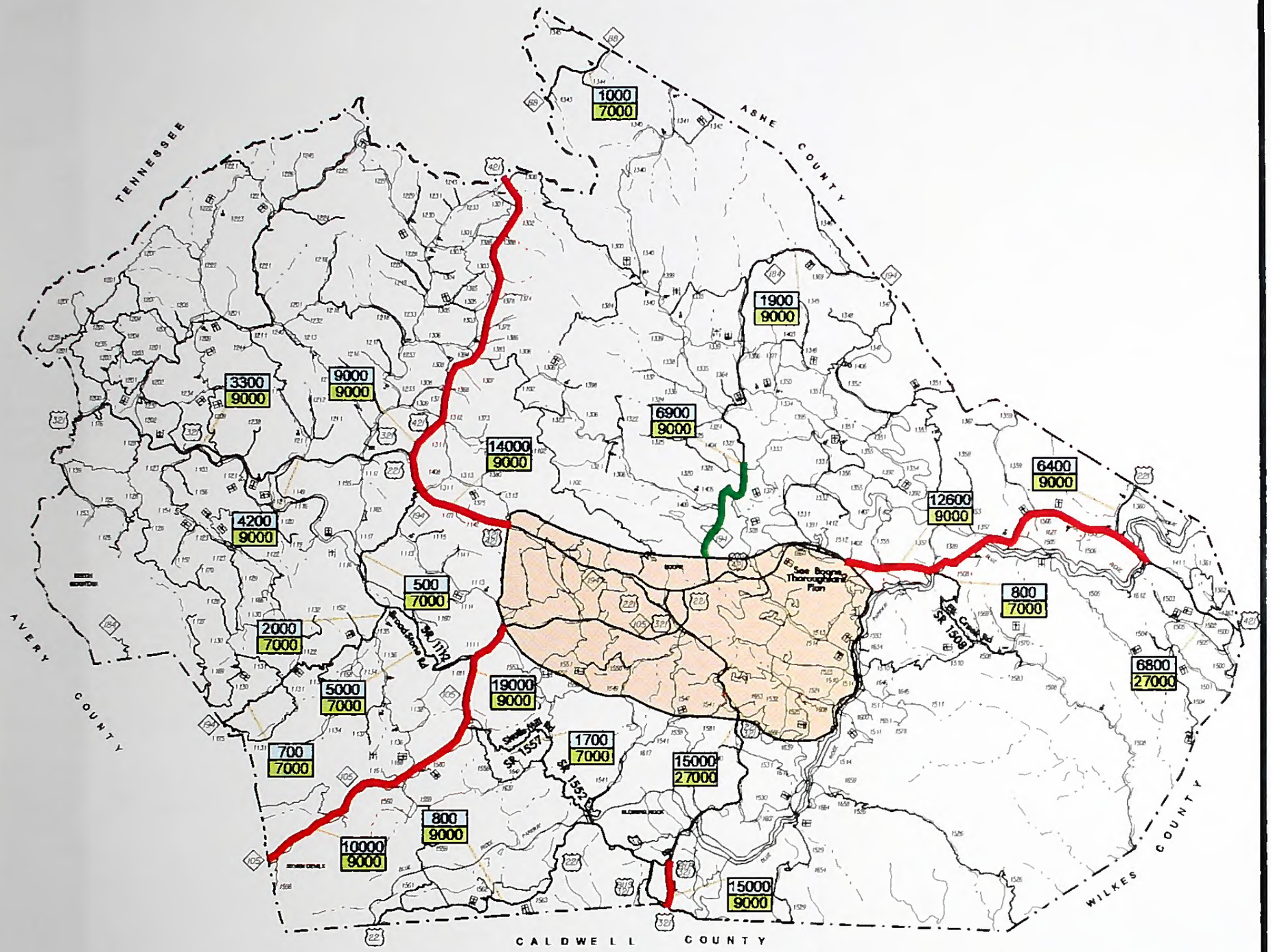


LOS F.

LEVELS OF SERVICE

Figure 5

2000 ADT & ROADWAY DEFICIENCIES



LEGEND

OVER CAPACITY

NEAR CAPACITY

2000 ADT CAPACITY
0000
0000

URBAN PLANNING BOUNDARY

WATAUGA COUNTY
NORTH CAROLINA

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FEDERAL HIGHWAY ADMINISTRATION

0 1 2 3 4 Miles

FIGURE 6

Traffic Crashes

Traffic crash statistics can often be used as an indicator for locating congestion problems. Traffic crash records can also be reviewed to identify problem locations or deficiencies such as substandard design, inadequate signing, ineffective parking, or poor sight distance. Crash patterns identified from analysis of crash data can lead to improvements that will reduce the number of crashes.

The NCDOT Traffic Engineering and Safety Systems Branch periodically reviews crash data statewide to identify areas where crash rates may be reduced as a result of roadway improvements. The Highway Safety Improvement Program identifies the highest crash intersections so that they may be studied further. To be included in the program, each location must meet one of several warrants, or minimum criteria. For intersections, the categories of warrants are front impact crash rate, previous year crash rate, severity index levels, and night crash rate without streetlights.

Crash data is given by type in order to identify any trends that may be correctable through roadway or intersection improvements. The total number of crashes and the average crash severity are useful for ranking the most problematic intersections. The severity index is based on a series of weighting factors developed by the NCDOT. These factors define a fatal or incapacitating crash as 47.7 times more severe than one involving only property damage, and a crash resulting in minor injury as 11.8 times more severe than one with only property damage. In general, a higher severity index indicates more severe crashes. Listed below are levels of severity for various severity index ranges.

Severity	Severity Index
low	< 6.0
average	6.0 to 7.0
moderate	7.0 to 14.0
high	14.0 to 20.0
very high	> 20.0

Table 6 is a summary of the intersections in Watauga County with the highest crash rates. For each intersection, the total number of crashes is given by type. The criterion used to identify these locations includes all crashes within 200 feet of an intersection over a three-year period, between January 1997 and July 2000. To request a more detailed crash analysis for any of the above mentioned intersections, or other intersections of concern, the appropriate Area Traffic Engineer, which is Area 4 for Watauga County, should be contacted.

Table 6

Watauga County Highest Crash Intersections

Location Number	Intersection	Angle	Rear End	Run Off Road	Left Turn	Right Turn	Other	Total
1	US 421 / NC 194	4	17		6	1	1	29
2	NC 105 / SR 1112	4	10	2	7		1	24
3	US 421 / SR 1357		6	2	1		3	12
4	US 421 / SR 1355		7	3				10
5	US 421 / Blue Ridge Parkway		7		3			10
6	US 421 / SR 1312	1	5		3		1	10

Existing Bridge Conditions

Bridges are a vital and unique element of a highway system. First, they represent the highest unit investment of all elements of the system. Second, any inadequacy or deficiency in a bridge reduces the value of the total investment. Third, a bridge presents the greatest opportunity of all potential highway failures for disruption of community welfare. Finally, and most importantly, a bridge represents the greatest opportunity of all highway failures for loss of life. For these reasons, it is imperative that bridges be constructed to the same design standards as the system of which they are a part.

Congress enacted the National Bridge Inspection Program Standards on April 27, 1971, implementing the Federal Highway Act of 1968. These standards require that "all structures designed as bridges located on any of the Federal-Aid Highway Systems be inspected and the safe load carrying capacity computed at regular intervals, not to exceed two years." The NCDOT Bridge Maintenance Unit, with assistance from various consultants, inspects all bridges on the State Highway System.

The Transportation Improvement Program (TIP) development process for bridge projects involves consideration of several evaluation methods in order to prioritize needed improvements. A sufficiency index is used to determine whether a bridge is sufficient to remain in service, or to what extent it is deficient. The index is a percentage in which 100 percent represents an entirely sufficient bridge and zero represents an entirely insufficient or deficient bridge. Factors evaluated in calculating the index are listed below.

- structural adequacy and safety
- serviceability and functional obsolescence
- essentiality for public use
- type of structure
- traffic safety features

A bridge is considered deficient if it is either structurally deficient or functionally obsolete. Bridges in the functionally obsolete category have below average ratings in approach roadway alignment, under clearance, deck geometry, waterway adequacy, or structural condition. Structurally deficient bridges have below average ratings in deck superstructure, substructure, overall structural conditions, or waterway adequacy. A bridge must be classified as deficient before it is eligible for Federal Bridge Replacement Funds. The sufficiency rating must be less than 50 to qualify for replacement or less than 80 to qualify for rehabilitation under federal funding.

In addition to the sufficiency index, further analysis is performed using the Level of Service Analysis and Prioritization (LOSAP) program. This program ranks bridges by deficiency points, which are calculated based on maintaining desired levels of service. The levels of service for lane and shoulder width, vertical clearance, and load capacity vary with roadway functional classification and average daily traffic. Another tool for prioritizing bridge improvements is the Optimum Bridge Budget Forecasting and Allocation System (OPBRIDGE). This program determines the optimum improvement action and time for each bridge in a network given certain level of service goals and funding constraints.

The output from each of these evaluation methods, along with input from NCDOT Bridge Maintenance personnel and local communities, is used to prioritize bridge projects. Bridges with the highest priority are replaced as federal and state funds become available.

All bridges in Watauga County have been analyzed, rated, and inventoried. Table 7 shows the fifteen functionally obsolete bridges and Table 8 shows the fifteen most structurally deficient bridges in the county.

Table 7

Functionally Obsolete Bridges in Watauga County

Bridge No.	Facility Carried	Water Source	Location	Rating
317*	SR 1355	S. Fork New River	1.5 Mi. S. Jct. SR 1392	32.3
82	SR 1103	Watauga River	0.1 Mi. N Jct. SR 1121	36.3
49*	SR 1522	Creek	.1 Mi E. Jct. SR 1521	36.9
319	SR 1594	Watauga River	.2 Mi. S. Jct. NC 105	38.1
132	SR 1306	Cove Creek	100 Ft. E. Jct. SR 1233	39.1
38	SR 1337	Meat Camp Creek	.01 Mi. W. Jct. SR 1335	40.7
93	SR 1109	Creek	.1 Mi. N. Jct. NC 105	44.0
10*	SR 1547	Boone Creek	150 Ft. S. Jct. US 321	45.9
106*	SR 1117	Brushy Fork Creek	50 Ft. S. Jct. US 321	46.7
279	SR 1203	Creek	10 Ft. S. Jct. SR 1204	47.4
196	SR 1134	Dutch Creek	1.4 Mi. S. Jct. SR 1158	47.7
29*	US 321	Cove Creek	.1 Mi. W. Jct. SR 1233	47.8
161*	SR 1114	Watauga River	150 Ft. W. Jct. SR 1160	48.4
90	SR 1311	Creek	50 Ft. S. Jct. SR 1312	48.6
25	SR 1225	Creek	.25 Mi. N. Jct. SR 1224	49.0

Notes: * Denotes the bridge is in the current Transportation Improvement Program.

Table 8

Fifteen Most Structurally Deficient Bridges in Watauga County

Bridge No.	Facility Carried	Water Source	Location	Rating
324*	SR 1542	Middle Fork Creek	50 Ft. S. Jct. SR 1543	2.0
12*	SR 1549	Flannery Fork Creek	.2 Mi. W. Jct. SR 1547	3.0
43*	SR 1306	Howards Creek	.1 Mi. W. Jct. SR 1393	6.0
175	SR 1524	Goshen Creek	100 Ft. W. Jct. SR 1514	13.6
33*	SR 1335	Meat Camp Creek	.3 Mi. N. Jct. SR 1339	14.6
50*	SR 1522	Creek	.2 Mi. NE. Jct. SR 1521	25.2
94*	SR 1111	Creek	200 Ft. W. Jct. NC 105	27.4
149	SR 1351	Creek	.3 Mi. SW. Jct. SR 1352	27.5
86*	SR 1328	Howards Creek	.1 Mi. S. Jct. NC 194	28.9
128	SR 1500	Stoney Fork Creek	50 Ft. S. Jct. SR 1501	29.3
59	SR 1331	South Fork New River	75 Ft. N. Jct. SR 1332	29.5
320*	SR 1153	Creek	300 Ft. W. Jct. SR 1125	29.9
231	SR 1337	Meat Camp Creek	.1 Mi. W. Jct. SR 1336	31.9
80*	SR 1136	Clarks Creek	.4 Mi. N. Jct. SR 1137	33.9
209*	SR 1508	Laurel Fork Creek	4.5 Mi. S. Jct. SR 1583	34.1

Notes: * Denotes the bridge is in the current Transportation Improvement Program.

Factors Affecting the Future Roadway System

The objective of thoroughfare planning is to develop a transportation system that will meet future travel demand and enable people and goods to travel safely and efficiently. To determine the needs of an area it is important to understand the effect of population, economics and land use on the roadway system. Examination of these factors helps to explain historic travel patterns and lays the groundwork for thoroughfare planning.

Population

The amount of traffic on a section of roadway is a function of the size and location of the population that it serves. Investigating past trends in population growth and projecting future population growth and dispersion is an essential step in transportation planning. Table 9 shows the historical trends and projected population for Watauga County through the year 2030. Table 10 shows population trends by municipalities.

Table 9

Watauga County Population Trends and Projections

Year	Population	Percent Growth
1970	23,404	
1980	31,666	+35.3
1990	36,952	+16.7
2000	42,033	+13.8
2010	45,608[a]	+8.5
2020	47,624[a]	+4.4
2030	54,682[b]	+14.8

Note: a - Estimate by the Office of State Budget and Management
b - Projection

Table 10

Watauga County Population by Township

Municipalities	1970	1980	1990	2000	1990 – 2000
Beech Mountain	-	190	239	311	+72 / 3.01%
Blowing Rock	801	1,337	1,263	1,423	+160 / 1.27%
Boone	8,754	10,191	12,949	13,502	+553 / 0.43%
Seven Devils	-	54	117	129	+12 / 1.03%

Economy and Employment

Another important factor to be considered in estimating the future traffic growth of an area is its economic base. The number of employers and the average per capita income, or purchasing power, influences how much population can be supported in an area and the number of motor vehicles that will be locally owned and operated. Generally, as family income increases so does the number of vehicles owned, as well as the number of vehicles trips generated per day by each

household. An accurate projection of the future economy of an area is essential in estimating future travel demand.

Factors that will influence economic growth and development in Watauga County over the thirty-three year planning period include the expansion of the Boone urban area. Another influence on the future economic growth of Watauga County is the increase in student population at Appalachian State. Increased amounts of tourism and development may also result in secondary growth for Watauga County.

Land Use

Land use refers to the physical patterns of activities and functions within a municipality or county. Traffic problems in a given area often can be attributed to adjacent land use. For example, a large industrial plant may cause congestion during shift change hours on a road that otherwise has little, if any, congestion. The spatial distribution of different types of land uses is a predominant determinant of when, where, and to what extent traffic congestion occurs. The travel demand between different land uses and the resulting impact on traffic conditions varies depending on the size, type, intensity, and spatial separation of development.

For use in transportation planning, land uses are grouped into the categories defined below.

- **Residential** - land devoted to the housing of people (excludes hotels and motels)
- **Commercial** - land devoted to retail trade, including consumer and business services and offices
- **Industrial** - land devoted to manufacturing, storage, warehousing, and transportation of products
- **Public** - land devoted to social, religious, educational, cultural, and political activities

Anticipated future land use is a logical extension of the present spatial distribution. Determination of where and what type of growth is expected to occur within the planning area facilitates developing proposed thoroughfares or the improvement of existing thoroughfares. Areas of anticipated development and growth for Watauga County are listed below.

- Residential – Boone, Blowing Rock, and Beech Mountain
- Commercial/Retail – Boone, Blowing Rock
- Industrial – Boone
- Public – Preserve and improve the physical environment especially water quality. Also preserve all historic sites and the rural atmosphere.

The largest growth expectations are for southern Watauga County. This development is anticipated primarily along US 421, US 321, US 221, NC 194, NC 105 south of Boone, and US 421 north of Boone to Vilas, which many are scheduled in the TIP for improvements, including an alternative route for US 421 through Boone. It is expected that the residential growth will take place in the towns, but primarily in the unincorporated areas. The industrial growth is not as certain, but may be more widespread and not concentrated in one area.

Forecasted Travel Patterns and Deficiencies

Future Travel Demand

Future travel demand can be forecasted by looking at past traffic trends and calculating the average annual growth rates for specific routes. Using historical traffic trends, along with projected land use and projected population growth, future travel demand can be estimated and future transportation deficiencies can be identified. For this thoroughfare plan study average daily traffic (ADT) counts for the past thirty years were used in a linear regression analysis to estimate ADT for the planning year 2030. The projected 2030 ADT for Watauga County's functionally classified roads are shown in Figure 7 and listed in Appendix B, Table B-1.

Capacity Deficient Corridors

Capacity deficient corridors are identified using the volume to capacity ratio (V/C), which is the projected traffic over the practical capacity of the facility for a given level of service (LOS). For this analysis, capacity is based on LOS C, except LOS B for rural roadways functionally classified as arterials. A V/C ratio greater than one indicates the volume of traffic on the road exceeds its capacity and the facility should be considered for improvement. Based on this analysis, the roads in Watauga County listed below are anticipated to be over capacity by the planning year 2030.

- US 421: From the Blue Ridge Parkway to the eastern Boone Urban Planning Boundary (BUPB) and from the western BUPB to the Tennessee State Line
- NC 105: From the BUPB to the Avery County Line
- US 321(south): From north of US 221 interchange to the Caldwell County Line
- NC 194: From US 421 to SR 1327 (Jack Hayes Road)
- US 221: From US 421 to the Ashe County Line
- SR 1112 (Broadstone Road): From NC 105 to NC 194

US 421, NC 194, NC 105, US 321, and US 221 are scheduled for improvements in the 2002-2008 Transportation Improvement Program (TIP). Refer to Figure 7 for depiction of these deficient corridors and to Chapter 2 for recommendations. Widening these facilities will increase their traffic carrying ability and alleviate traffic congestion. The existing and recommended capacities, right-of-way, and cross sections for Watauga County's functionally classified roads are given in Appendix B, Table B-1.

Roads Approaching Capacity

A V/C ratio greater than .8 indicates the volume of traffic on the road is near its capacity and the facility will eventually need to be considered for improvement. Listed below are the other roads in the planning area that are expected to have congestion problems within the planning period.

- US 321(south): From BUPB to US 221 Interchange
- US 321(west): From US 421 to SR 1211 (Phillips Branch Road)

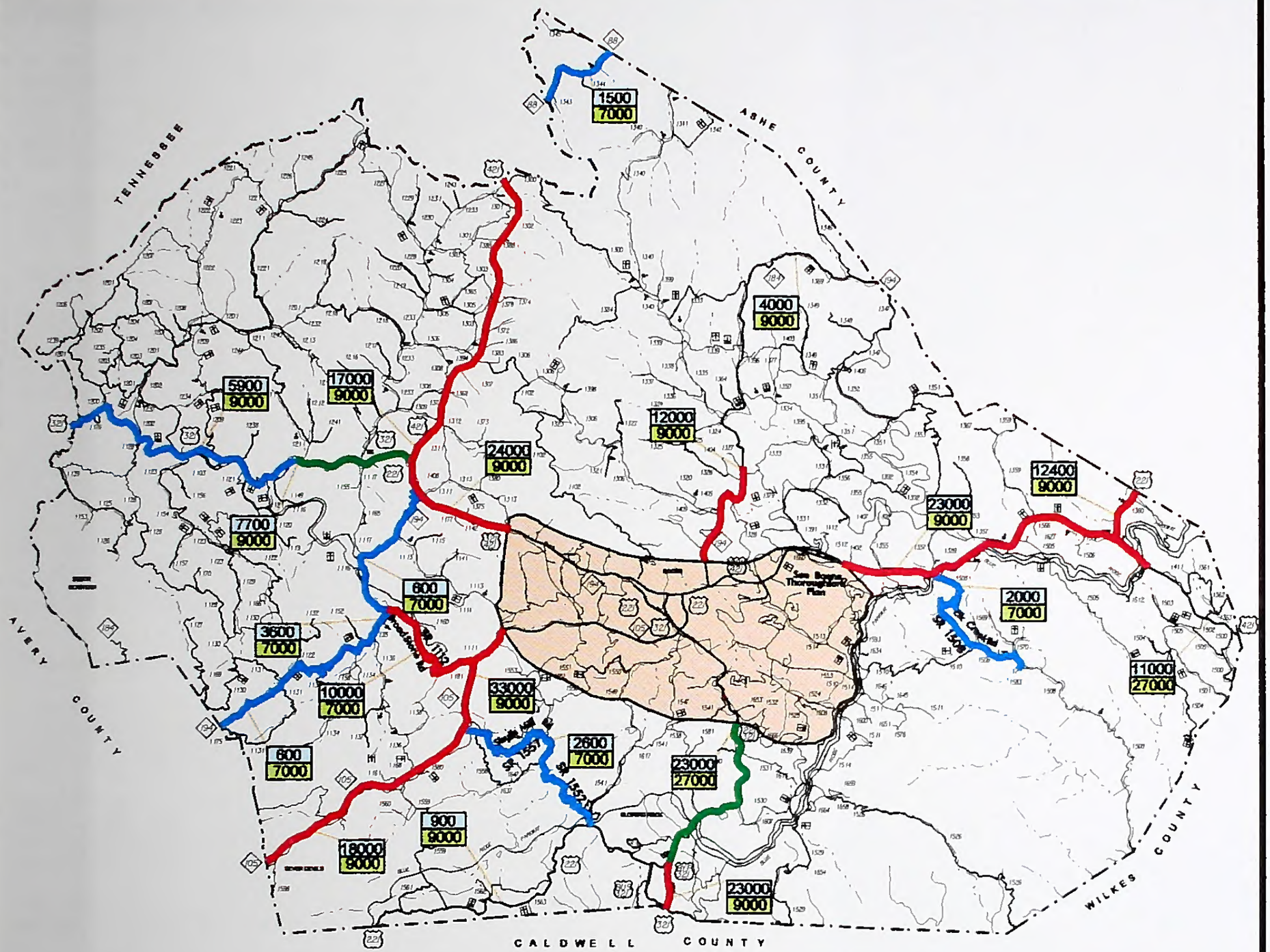
System Deficiencies

System deficiencies result in areas that lack a cohesive, continuous, and complimentary major road network. More simply put, a system deficiency exists when drivers must go out of their way to get to their desired destination, or when the route is not cohesive or continuous. For Watauga County, no system deficiencies were identified that warrant improvements.

Intersection Deficiencies

Ineffective intersection design or control can contribute to poor traffic flow, increased traffic crashes, and driver irritation. Most of the major traffic intersections in Watauga County are located within the municipalities. Analysis of Watauga County's roadway system did not reveal any intersection deficiencies.

2030 ADT & ROADWAY DEFICIENCIES



LEGEND

- OVER CAPACITY
- NEAR CAPACITY
- SUBSTANDARD DESIGN
- 2030 ADT / CAPACITY (0000 / 0000)
- URBAN PLANNING BOUNDARY

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FEDERAL HIGHWAY ADMINISTRATION

0 1 2 3 4 Miles

FIGURE 7

Consideration of Environmental Factors

In recent years, environmental considerations associated with highway improvements or construction have come to the forefront of the planning process. The legislation that dictates the necessary procedures regarding environmental impacts is the National Environmental Policy Act. Section 102 of this act requires the execution of an environmental impact statement (EIS) for road projects that have a significant impact on the environment. An EIS includes an evaluation of a project's impact on wetlands, water quality, historic properties, wildlife, and public lands.

Although the technical report for the thoroughfare plan is not intended to cover environmental concerns in as much detail as an EIS, preliminary research on environmental factors is generally done at the thoroughfare planning stage and is included below.

Wetlands

In general terms, wetlands are lands where saturation with water is the dominant factor in determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. The single feature that most wetlands share is soil or substrata that is at least periodically saturated with or covered by water. Water creates severe physiological problems for all plants and animals except those that are adapted for life in it or in saturated soil.

Wetlands are crucial ecosystems in our environment. They help regulate and maintain the hydrology of our rivers, lakes, and streams by slowly storing and releasing floodwaters. They help maintain the quality of our water by storing nutrients, reducing sediment loads, and reducing erosion. They are also critical to fish and wildlife populations. Wetlands provide an important habitat for about one third of the plant and animal species that are federally listed as threatened or endangered.

The impacts to wetlands can be evaluated using the National Wetlands Inventory Mapping, available from the U. S. Fish and Wildlife Service. Wetland impacts will be avoided or minimized to the greatest extent possible while preserving the integrity of the thoroughfare plan.

Threatened and Endangered Species

A preliminary review of Federally Listed Threatened and Endangered Species within Watauga County was done to determine the effect improvements to existing facilities or the construction of new facilities could have on wildlife. Threatened or endangered species were identified using mapping from the North Carolina Department of Environment, Health, and Natural Resources.

The Threatened and Endangered Species Act of 1973 allows the U. S. Fish and Wildlife Service to impose measures for mitigation of the environmental impacts of a road project on endangered plants and animals and critical wildlife habitats. By locating rare species in the planning stage of road construction, avoidance or minimization of these impacts is possible.

There were various sightings of rare plants and animals throughout Watauga County. Projects of particular concern with respect to rare plants and animals include:

- NC 105 Widening (Mechanta Cordata, Eurycea Longcanda)
- NC 194(north) (Pteromarcys Proteus)

A detailed field investigation of these corridors is recommended prior to construction of any highway project in this area.

Historic Sites

The locations of historic sites in Watauga County were investigated to determine the possible impacts of the various projects studied. The federal government has issued guidelines requiring all state transportation departments to make special efforts to preserve historic sites. In addition, the State of North Carolina has issued its own guidelines for the preservation of historic sites. These two pieces of legislation are described below.

> **National Historic Preservation Act** - Section 106 of this act requires state departments of transportation to identify historic properties listed in the National Register of Historic Places and properties eligible to be listed. State departments of transportation must consider the impacts of its road projects on these properties and consult with the Federal Advisory Council on Historic Preservation.
>
> **NC General Statute 121-12(a)** - This statute requires the NCDOT to identify historic properties listed on the National Register, but not necessarily those eligible to be listed. NCDOT must consider impacts and consult with the North Carolina Historical Commission, but is not bound by their recommendations.

The State Plan for Historic Preservation was used to identify sites within Watauga County. Many of these sites are located in the western portions of the county. The following are historic sites that are listed on the National Register of Historical Properties.

- NC 194(south)- Valle Crucis Episcopal Mission Church located approximately .5 miles south of SR 1112 (Broadstone Road).
- US 321(west)- Ward Family House located approximately .5 miles west of SR 1211 (Phillips Branch Road)

All reasonable efforts will be made to minimize the impact to identified historic sites and natural settings when widening existing roadways or constructing new facilities. None of the other properties should be affected by the projects proposed on the thoroughfare plan. However, care should be taken to make certain that all historic sites and natural settings are preserved. Therefore, a more detailed study should be done in regard to local historic sites prior to construction of any project.

Archaeology

Archaeological sites were found along US 321(west), NC 194(south), US 321/421 and SR 1552. All efforts will be made to avoid or minimize any impacts to archaeological sites prior to any roadway improvements or construction. Therefore, a more detailed study should be done in regard to local historic sites prior to construction of any project.

APPENDICES

Appendix A
Thoroughfare Planning Principles

There are many advantages to thoroughfare planning, but the primary objective is to assure that the road system will be progressively developed to serve future travel desires. Thus, the main consideration in thoroughfare planning is to make provisions for street and highway improvements so that, when the need arises, feasible opportunities to make improvements exist.

Benefits of Thoroughfare Planning

There are two major benefits derived from thoroughfare planning. First, each road is designed to perform a specific function and provide a specific level of service. This permits savings in right-of-way, construction, and maintenance costs. It also protects residential neighborhoods and encourages stability in travel and land use patterns. Second, thoroughfare planning allows local officials to be informed of future improvements and enables them to incorporate this information into planning and policy decisions. This permits developers to design subdivisions in a non-conflicting manner, enables school and park officials to better locate their facilities, and minimizes the damage to property values and community appearance that could otherwise be associated with roadway improvements.

County Thoroughfare Planning Concepts

The purpose of the thoroughfare planning is to provide a functional roadway system that permits direct, efficient, and safe travel. Different elements in the system are designed to have specific functions and levels of service, thus minimizing the traffic and land service conflict.

In a county thoroughfare plan, elements are either urban or rural. In an urban planning area, the local municipality generally has planning jurisdiction. Outside the urban planning area, the county has planning jurisdiction. In those urban areas where no urban thoroughfare plan exists, elements are rural and are under the planning jurisdiction of the county.

Within both urban and rural systems, transportation elements are classified according to the specific function they are designed to perform. A discussion of the elements and functions of the two systems follows.

Thoroughfare Classification Systems

Roads perform two primary functions, traffic service and land access. These functions can be served effectively when both traffic volumes and demand to access land are low. However, when traffic volumes are high, conflicts created by uncontrolled and intensely developed abutting property may lead to intolerable traffic flow friction and congestion.

The underlying concept of a thoroughfare plan is that it provides a functional system of roads that permits travel from origins to destinations with directness, ease, and safety. Different roads in this system are designed to perform specific functions, thus minimizing the conflict between traffic service and land access.

Urban Classification

For urban thoroughfare plans, roadways are classified as major thoroughfares, minor thoroughfares, or local access streets.

Major Thoroughfares
These routes are the primary traffic arteries of the urban area and they accommodate traffic movements within, around, and through the area.

Minor Thoroughfares
Roadways classified as this type collect traffic from the local access streets and carry it to the major thoroughfare system.

Local Access Streets
This classification includes all streets that have a primary purpose of providing access to the abutting property. This category is further classified as either residential, commercial and/or industrial, depending upon the type of land use that is served.

Due to the limited amount of detail that can be shown on a county thoroughfare plan, only urban major thoroughfares are shown.

Rural Classification

A rural classification system is used for county thoroughfare plans, which also show the major thoroughfares within urban thoroughfare planning boundaries. There are four major systems in the rural classification system: principal arterials, minor arterials, major and minor collectors, and local roads.

Rural Principal Arterial System
The principal arterial system is a connected network of continuous routes that serve corridor movements having substantial statewide or interstate travel characteristics. Longer trip lengths and greater travel densities characterize this type of travel. The principal arterial system should serve all urban areas of over 50,000 in population and most of those with a population greater than 5,000. The interstate system constitutes a significant portion of the principal arterial system.

Rural Minor Arterial System
The minor arterial system forms a network that links cities, large towns, and other major traffic generators, such as large resorts. The minor arterial system generally serves intrastate and intercounty travel and travel corridors with trip lengths and travel densities somewhat less than the principal arterial system.

Rural Collector Road System

The rural collector routes generally serve intracounty travel. These routes serve travel whose distances are shorter than on the arterial routes. The rural collector road system is subclassified into major and minor collector roads.

Major Collector Roads

These routes provide service to most sizable towns not directly served by the higher systems and to other traffic generators of equivalent intracounty importance, such as consolidated schools, shipping points, county parks, significant mining and agricultural areas, etc. Major collector roads also link these places to routes of higher classification and serve the more important intracounty travel corridors.

Minor Collector Roads

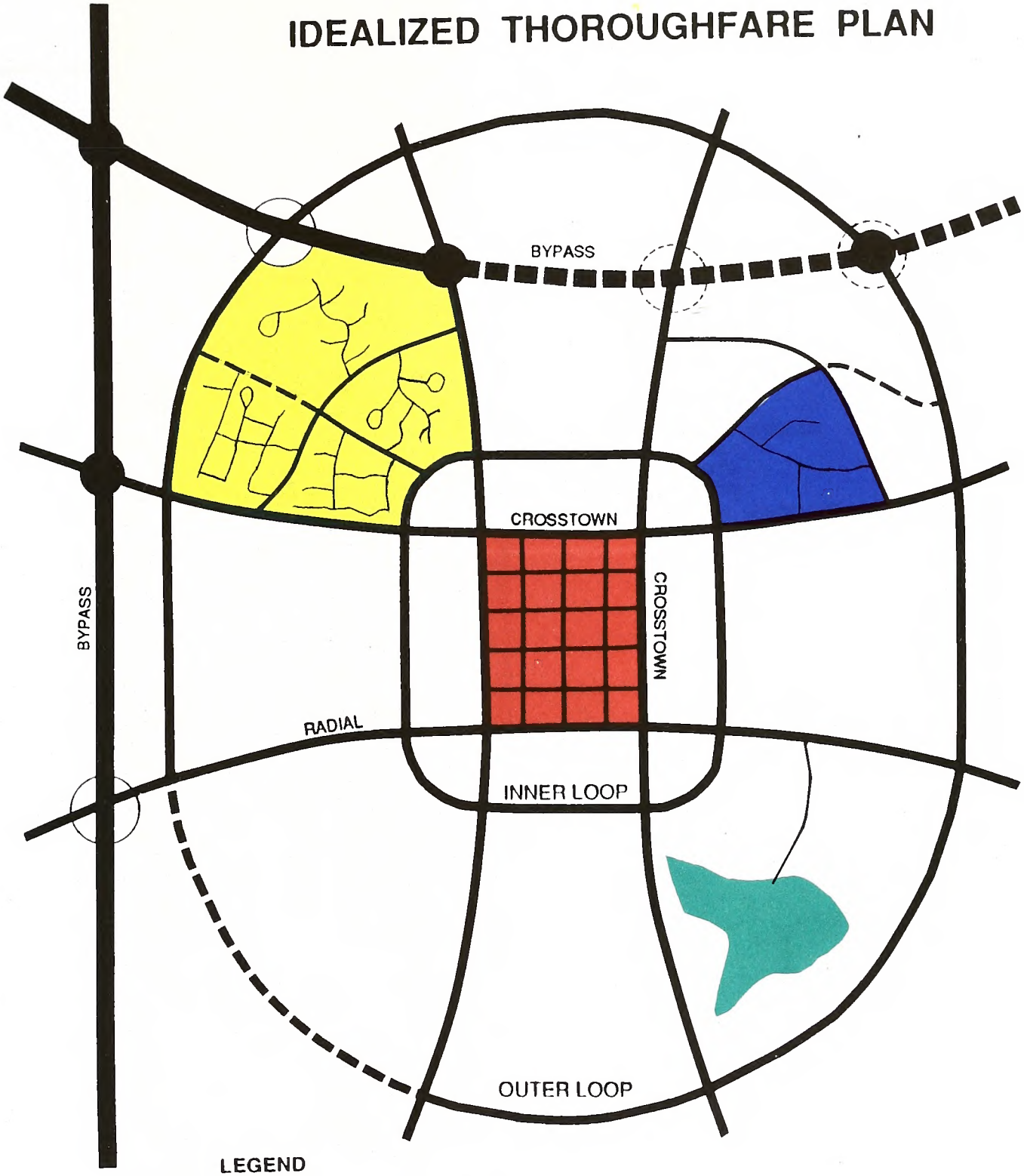
These roads collect traffic from local roads and provide a link within a reasonable distance to a major collector road. Minor collectors also provide service to the remaining smaller communities and link rural areas to the locally important traffic generators.

Rural Local Road System

The local road system consists of all facilities not on a higher system. Local residential streets and residential collector streets are elements of this system. Facilities designated as local residential streets are either cul-de-sacs, loop streets less than 2,500 feet in length, or streets less than one mile in length. These streets do not connect thoroughfares or serve major traffic generators and do not collect traffic from more than one hundred dwelling units. Residential collector streets serve as the connecting street system between local residential streets and the thoroughfare system.

Figure A-1 gives a schematic illustration of the functional classification of a rural highway system. The functional classification for Watauga County is shown in Figure A-2.

IDEALIZED THOROUGHFARE PLAN



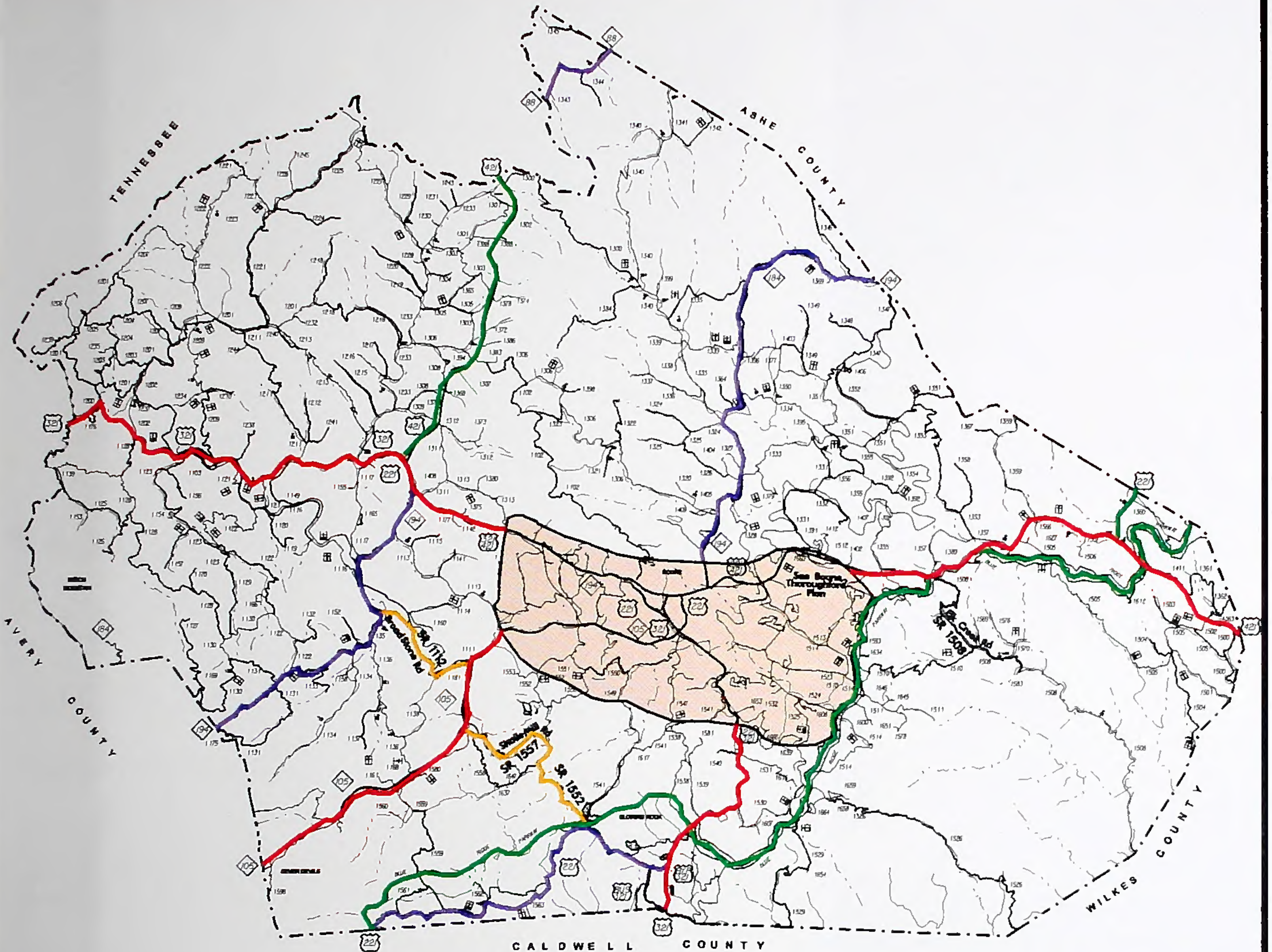
LEGEND

	EXISTING	PROPOSED
MAJOR THOROUGHFARE FREEWAY		
MAJOR OTHER		
MINOR THOROUGHFARE		
LOCAL ROAD		
INTERCHANGE		
GRADE SEPERATION		

LAND USES

- COMMERCIAL/BUSINESS
- RESIDENTIAL
- INDUSTRIAL
- PUBLIC/INSTITUTIONAL

Figure A-1



FUNCTIONAL CLASSIFICATION

LEGEND

INTERSTATE
OTHER PRINCIPAL ARTERIAL
MINOR ARTERIAL
MAJOR COLLECTOR
MINOR COLLECTOR
URBAN PLANNING BOUNDARY

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0 1 2 3 4 Miles

FIGURE A-2

Objectives of Thoroughfare Planning

Thoroughfare planning is the process public officials use to assure the development of the most appropriate roadway system to meet existing and future travel desires within the urban area or county. The primary aim of a thoroughfare plan is to guide the development of the roadway system in a manner consistent with changing traffic patterns. Thoroughfare planning enables road improvements to be made as traffic demands increase and ensure only needed improvements are implemented, eliminating the expense of unnecessary projects. By developing the roadway system to keep pace with increasing traffic demands, maximum utilization of the system can be attained, requiring a minimum amount of land for transportation purposes. In addition to providing for traffic needs, urban thoroughfare plans should embody those details of good urban planning necessary to present a pleasing and efficient urban community. The present and future population dispersion, as well as commercial and industrial development, affect major street and highway locations. Conversely, the location of major streets and highways within a given area influences the local development pattern.

Objectives of a thoroughfare plan include:

- To provide for the orderly development of an adequate major roadway system as land development occurs;
- To reduce travel and transportation costs;
- To reduce the cost of major roadway improvements to the public through the coordination of the roadway system with private action;
- To enable private interest to plan their actions, improvements, and development with full knowledge of public intent;
- To minimize disruption and displacement of people and businesses through long range advance planning for major roadway improvements;
- To reduce environmental impacts, such as air pollution, resulting from transportation, and
- To increase travel safety.

These objectives are achieved through improving both the operational efficiency of thoroughfares, and improving the system efficiency through system coordination and layout.

Operational Efficiency

The operational efficiency of a road is improved by increasing the capability of the street to carry more vehicular traffic and people. In terms of vehicular traffic, a road's capacity is defined by the maximum number of vehicles that can pass a given point on a road during a given time period under prevailing roadway and traffic conditions. Capacity is affected by the physical features of the roadway, prevailing traffic characteristics, and weather.

Physical ways to improve vehicular capacity include:

- **Roadway widening** - Widening of a road from two to four lanes more than doubles the capacity of the road by providing additional maneuverability for traffic.
- **Intersection improvements** - Increasing the turning radii, adding exclusive turn lanes, and channelizing movements can improve the capacity of an existing intersection.
- **Improving vertical and horizontal alignment** - Alignment improvements reduce congestion caused by slow moving vehicles.
- **Eliminating roadside obstacles** - Improving lateral clearance reduces side friction and improves a driver's field of sight.

Operational ways to improve a road's capacity include:

- **Control of Access** - A roadway with complete access control can often carry three times the traffic handled by a non-controlled access road with identical width and number of lanes.
- **Parking removal** - Capacity is increased by providing additional roadway width for traffic flow and reducing friction to flow caused by parking and unparking vehicles.
- **One-way operation** - The capacity of a street can be increased by 20 -50%, depending upon turning movements and overall street width, by initiating one-way traffic operations. One-way streets can also improve traffic flow by decreasing potential traffic conflicts and simplifying traffic signal coordination.
- **Reversible lanes** - Reversible traffic lanes may be used to increase street capacity in situations where heavy directional flows occur during peak periods.
- **Signal phasing and coordination** - Uncoordinated signals and poor signal phasing restrict traffic flow by creating excessive stop-and-go operation.

Altering travel demand is a third way to improve the efficiency of existing streets. Travel demand can be reduced in the following ways:

- **Carpools** - Encouraging the formation of carpools and vanpools for journeys to work and other trip purposes reduces the number of vehicles on the roadway and raises the people carrying capability of the street system.
- **Alternate mode** - Encouragement of transit and bicycle use reduces vehicular congestion.
- **Work hours** - Programs by industries, businesses, and institutions to stagger work hours or establish variable work hours for employees spreads peak travel over a longer time period and thus reduces peak hour demand.
- **Land use** - Planning land use can control development or redevelopment in a more travel efficient manner.

System Efficiency

Another means for altering travel demand on existing facilities is the development of a more efficient system of roads that will better serve travel desires. A more efficient transportation system can reduce travel distances, time, and user costs. Improvements in system efficiency can be achieved through the concept of functional classification of roads and development of a coordinated major street system.

Application of Thoroughfare Planning Principles

The concepts presented in the discussion of thoroughfare classification systems, operational efficiency and system efficiency, are conceptual tools available to aid in developing a thoroughfare plan. However, in practice thoroughfare planning is done for established urban areas or counties and is constrained by existing land use and street patterns, existing public attitudes and goals, and current expectations of future land use. Compromises must be made because of these and the many other factors that affect road locations.

Through the thoroughfare planning process it is necessary, from a practical viewpoint, that certain basic principles be followed as closely as possible. These principles are listed below.

1. The plan should be derived from a thorough knowledge of existing travel - its component parts, and the factors that contribute to it, limit it, and modify it.

2. Traffic demands must be sufficient to warrant the designation and development of each facility. The thoroughfare plan should be designed to accommodate a large portion of major traffic movements on a few roads.

3. The plan should conform to and provide for the land development plan for the area.

4. Certain considerations must be given to development beyond the current planning period. Particularly in outlying or sparsely developed areas that have development potential, it is necessary to designate thoroughfares on a long-range planning basis to protect rights-of-way for future thoroughfare development.

5. While being consistent with the above principles and realistic in terms of travel trends, the thoroughfare plan must be economically feasible.

Appendix B
Thoroughfare Plan Street Tabulation and Recommendations

This appendix includes a detailed tabulation of all roads identified as elements of the Watauga County Thoroughfare Plan. The table includes a description of the roads by sections, as well as the length, cross section, and right-of-way for each section. Also included are the existing and projected average daily traffic volumes, the practical roadway capacity, and the recommended ultimate lane configuration. It should be noted that the practical capacities for rural roadways are based on a level of service of B for roads functionally classified as arterials and level of service C for all other roads. The practical capacity for all roads in urban areas are based on a level of service B. Refer to Chapter 4 for a description and illustration of the levels of service and Figure A-2 for the functional classification of Watauga County roads. Due to space constraints, the recommended cross-sections are given in the following form: number of lanes/ alphabetic code. A detailed description and illustrative figure for each of the alphabetic codes for cross sections can be found in Appendix C.

The following index of terms may be helpful in interpreting the table:

ADQ – Adequate
Co. – County
DIST – Distance
EXIST. – Existing
N/A – Not Available
No. – Number
REC. – Recommended
RDWY – Roadway
ROW – Right-of-Way
BUPB – Boone Urban Planning Boundary

Table B-1

Thoroughfare Plan Street Tabulation and Recommendations

FACILITY & SECTION	EXISTING CROSS SECTION							RECOMMENDATIONS			
	DIST mi	RDWY ft	ROW ft	NO. OF LANES	PRACTICAL CAPACITY	ADT 2000	ADT 2030	No. of Lanes	Capacity	CROSS-Section	ROW ft
US 421											
Wilkes Co. - SR 1361	1.60	48	100	4	27,000	6,800	11,000	ADQ			
SR 1361 - Blue Ridge Parkway	0.20	70	100	5	27,000	6,800	11,000	4	27,000	E/F	90/110
Blue Ridge Parkway - US 221	0.10	22	100	2	9,000	6,800	11,000	4	27,000	E/F	90/110
US 221 - SR 1357	2.80	24	100	2	9,000	6,800	11,000	4	27,000	E/F	90/110
SR 1357 - SR 1355	2.70	24	100	2	9,000	12,600	23,000	4	27,000	E/F	90/110
SR 1355 - SR 1402	0.60	24	100	2	9,000	12,600	23,000	4	27,000	E/F	90/110
SR 1402 - SR 1655	1.80	24	60	2	9,000	12,600	23,000	4	27,000	E/F	90/110
SR 1655 - Eastern BUPB	0.20	24	60	2	9,000	N/A	N/A	4	27,000	E/F	90/110
Eastern BUPB - NC 194	1.30	60	100	4	27,000	N/A	N/A	SEE			
NC 194 - US 221Junction	0.60	48	100	4	27,000	N/A	N/A	BOONE			
US 221 Junction - Green Street	1.80	28	100	2	6,000	N/A	N/A	THOROUGHFARE			
reen Street - Edgecliff Lane (Western BUPB	0.60	28	100	2	9,000	N/A	N/A	PLAN			
Edgecliff Lane - SR 1408	4.30	24	100	2	9,000	14,000	24,000	4	27,000	G	70
SR 1408 - US 321/421 Junction	0.50	24	100	2	9,000	9,000	19,000	4	27,000	G	70
US 321 Junction - Tennessee State line	6.50	24	150	2	9,000	9,000	19,000	4	27,000	G	70
US 321(west)											
US 421 - Cove Creek Bridge	1.50	24	100	2	9,000	4,200	7,700	ADQ			
Cove Creek Bridge - Avery Co.	7.00	20	100	2	9,000	3,300	5,900	2	8,000	K	70
NC 194(south)											
US 421 - SR 1117	2.60	17	60	2	7000	500	600	2	8,000	K	70
SR 1117 - SR 1112	0.70	18	60	2	7000	2,000	3600	2	8,000	K	70
SR 1112 - Avery Co.	5.10	20	60	2	7000	700	800	2	8,000	K	70
NC 105											
US 321 - Poplar Hill Road	1.20	48	100	4	27,000	N/A	N/A	SEE			
Poplar Road - SR 1102	0.80	60	100	5	27,000	N/A	N/A	BOONE			
SR 1102 - SR 1107	0.40	60	100	5	27,000	N/A	N/A	THROUGHFARE			
SR 1107 - Flintlock Road(BUPB)	1.30	36	100	3	13,500	N/A	N/A	PLAN			
Flintlock Road - SR 1580	4.00	28	100	2	9,000	19,000	33,000	5	36,000	C	90
SR 1580 - The Overlook Road	0.70	28	100	2	9,000	19,000	31,000	5	36,000	C	90
The Overlook Road - Valley Creek Lane	1.80	28	100	2	9,000	14,000	26,000	4	27,000	G	70
Valley Creek Lane - Avery Co.	2.70	28	100	2	9,000	10,000	18,000	4	27,000	G	70
US 221(south)											
Caldwell Co. - Blue Ridge Parkway	20.20	24	60	2	9,000	800	900	ADQ			
Blue Ridge Parkway - US 321	0.70	24	60	2	9,000	800	900	ADQ			

Table B-1

Thoroughfare Plan Street Tabulation and Recommendations

FACILITY & SECTION	EXISTING CROSS SECTION							RECOMMENDATIONS			
	DIST mi	RDWY ft	ROW ft	NO. OF LANES	PRACTICAL CAPACITY	ADT 2000	ADT 2030	No. of Lanes	Capacity	CROSS-Section	ROW ft
US 321											
US 421 - Boone SCL	1.30	60	60	5	31,500	N/A	N/A	SEE BOONE			
Boone SCL - SR 1532(BUPB)	1.00	48	100	4	27,000	21,000	34,000	THROUGHFARE PLAN			
SR 1532 - US 221/US 321 Bus	3.40	48	50	4	27,000	15,000	23,000	ADQ			
US 221/US 321Bus - Caldwell Co.	2.40	24	50	2	9,000	15,000	23,000	4	27,000	G	70
US 221 (north)											
US 421 - Ashe Co.	1.10	23	60	2	9,000	6,400	12,400	4	27,000	E/F	90/110
NC 194 (north)											
US 421 - SR 1319	1.20	24	60	2	9,000	9000	16,500	4	27,000	G	70
SR 1319 - SR 1327	1.00	22	60	2	9,000	6,900	12,000	3	13,500	H	60
SR 1327 - Ashe Co.	7.30	22	60	2	9,000	1,900	4,000	ADQ			
NC 88											
Tenn. State Line. - Ashe Co.	2.00	18	60	2	7000	1,000	1,500	2	8,000	K	70
SR 1557 Shulls Mill Rd.											
SR 1568 - SR 1552	2.60	16	N/A		7,000	1,700	2,600	2	8,000	K	70
SR 1112 Broadstone Rd.											
NC 194 - NC 105	2.80	22	60	2	7000	5,000	10,000	3	13,500	H	60
SR 1552 Poplar Grove Rd. South											
SR 1557 - US 221	2.20	20	60	2	7000	N/A	N/A	2	8,000	K	70
SR 1508 Elk Creek Rd.											
US 421 - SR 1583	10.00	18	60	2	7,000	800	2,000	2	8,000	K	70

Appendix C
Typical Thoroughfare Cross Sections

Cross section requirements for thoroughfares vary according to the desired capacity and level of service to be provided. Universal standards in the design of thoroughfares are not practical. Each roadway section must be individually analyzed and its cross section determined based on the volume and type of projected traffic, existing capacity, desired level of service, and available right-of-way. Based on this criteria, recommended typical cross-sections are given in Appendix B, Table B-1. Typical cross section recommendations are shown in Figure C-1. These cross sections are typical for facilities on new location and where right-of-way constraints are not critical. For widening projects and urban projects with limited right-of-way, special cross sections should be developed that meet the needs of the project.

On all existing and proposed major thoroughfares delineated on the thoroughfare plan, adequate right-of-way should be protected or acquired for the recommended cross sections. In addition to cross-section and right-of-way recommendations for improvements, Table B-1 may recommend ultimate needed right-of-way for the following situations:

- thoroughfares which may require widening after the current planning period,
- thoroughfares which are borderline adequate and accelerated traffic growth could render them deficient, and
- thoroughfares where an urban curb and gutter cross section may be locally desirable because of urban development or redevelopment.

Recommended design standards relating to grades, sight distances, degree of curve, super elevation, and other considerations for thoroughfares are given in Appendix D. The typical cross sections are described below.

A - Four Lanes Divided with Median - Freeway

Cross-section "A" is typical for four lane divided highways in rural areas that may have only partial or no control of access. The minimum median width for this cross section is 46 feet, but a wider median is desirable.

B - Seven Lanes - Curb & Gutter

Cross section "B" is typically not recommended for new projects. When the conditions warrant six lanes, cross section "D" should be recommended. Cross section "B" should be used only in special situations such as when widening from a five-lane section and right-of-way is limited. Even in these situations, consideration should be given to converting the center turn lane to a median so that cross section "D" is the final cross section.

C - Five Lanes - Curb & Gutter

Typical for major thoroughfares, cross section "C" is desirable where frequent left turns are anticipated as a result of abutting development or frequent street intersections.

D - Six Lanes Divided with Raised Median - Curb & Gutter/ E - Four Lanes Divided with Raised Median - Curb and Gutter

Cross sections "D" and "E" are typically used on major thoroughfares where left turns and intersection streets are not as frequent. Left turns would be restricted to a few selected intersections. The 16 ft median is the minimum recommended for an urban boulevard type cross section. In most instances, monolithic construction should be utilized due to greater cost effectiveness, ease and speed of placement, and reduced future maintenance requirements. In special cases, grassed or landscaped medians result in greatly increased maintenance costs and an increase in danger to maintenance personnel. Non-monolithic medians should only be recommended when the above concerns are addressed.

F - Four Lanes Divided - Boulevard, Grass Median

Cross-section "F" is typically recommended for urban boulevards or parkways to enhance the urban environment and to improve the compatibility of major thoroughfares with residential areas. A minimum median width of 24 ft is recommended with 30 ft being desirable.

G - Four Lanes - Curb & Gutter

Cross section "G" is recommended for major thoroughfares where projected travel indicates a need for four travel lanes but traffic is not excessively high, left turning movements are light, and right-of-way is restricted. An additional left turn lane would probably be required at major intersections. This cross section should be used only if the above criteria is met. If right-of-way is not restricted, future strip development could take place and the inner lanes could become de facto left turn lanes.

H - Three Lanes - Curb & Gutter

In urban environments, thoroughfares which are proposed to function as one-way traffic carriers would typically require cross section "H".

I - Two Lanes - C&G, Parking both sides: J - Two Lanes - C&G, Parking one side

Cross sections "I" and "J" are usually recommended for urban minor thoroughfares since these facilities usually serve both land service and traffic service functions. Cross section "I" would be used on those minor thoroughfares where parking on both sides is needed as a result of more intense development.

K - Two Lanes - Paved Shoulder

Cross section "K" is used in rural areas or for staged construction of a wider multi-lane cross section. On some thoroughfares, projected traffic volumes may indicate that two travel lanes will adequately serve travel for a considerable period of time. For areas that are growing and future widening will be necessary, the full right-of-way of 100 ft should be required. In some instances, local ordinances may not allow the full 100 ft. In those cases, 70 ft should be preserved with the understanding that the full 70 ft will be preserved by use of building setbacks and future street line ordinances.

L - Six Lanes Divided with Grass Median - Freeway

Cross section "L" is typical for controlled access freeways. The 46 ft grassed median is the minimum desirable median width, but there could be some variation from this depending upon design considerations. Right-of-way requirements would typically vary upward from 228 ft depending upon cut and fill requirements.

M - Eight Lanes Divided with Raised Median - Curb & Gutter

Also used for controlled access freeways, cross section "M" may be recommended for freeways going through major urban areas or for routes projected to carry very high volumes of traffic.

N - Five Lanes/C&G, Widened Curb Lanes; O - Two Lane/Shoulder Section; P - Four Lanes Divided/Raised Median, C&G, Widened Curb Lanes

If there is sufficient bicycle travel along the thoroughfare to justify a bicycle lane or bikeway, additional right-of-way may be required to contain the bicycle facilities. The North Carolina Bicycle Facilities Planning and Design Guidelines should be consulted for design standards for bicycle facilities. Cross sections "N", "O", and "P" are typically used to accommodate bicycle travel.

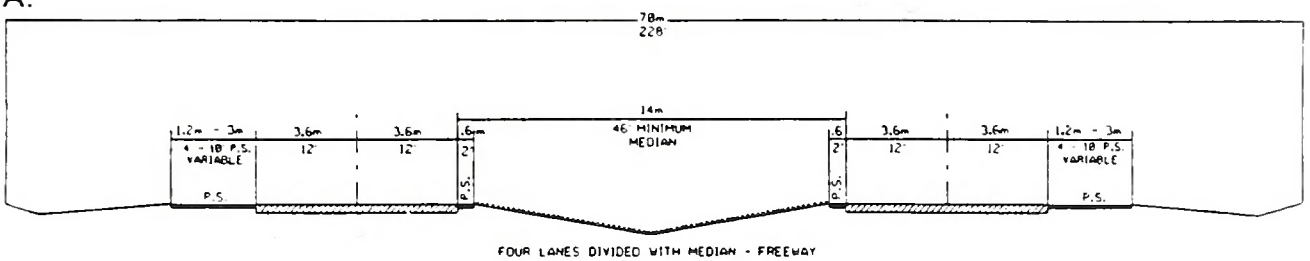
General

The urban curb and gutter cross sections all illustrate the sidewalk adjacent to the curb with a buffer or utility strip between the sidewalk and the minimum right-of-way line. This permits adequate setback for utility poles. If it is desired to move the sidewalk farther away from the street to provide additional separation for pedestrians or for aesthetic reasons, additional right-of-way must be provided to insure adequate setback for utility poles.

The right-of-way shown for each typical cross section is the minimum amount required to contain the street, sidewalks, utilities, and drainage facilities. Cut and fill requirements may require either additional right-of-way or construction easements. Obtaining construction easements is becoming the more common practice for urban thoroughfare construction.

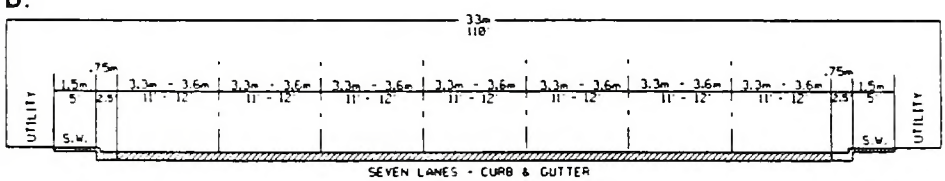
TYPICAL THOROUGHFARE CROSS SECTIONS

A.



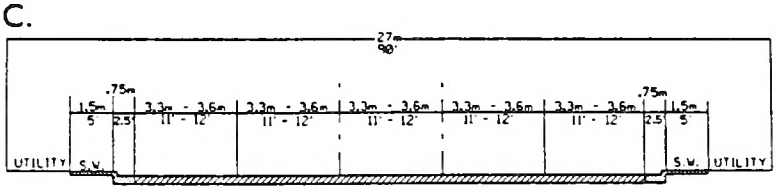
FOUR LANES DIVIDED WITH MEDIAN - FREEWAY

B.



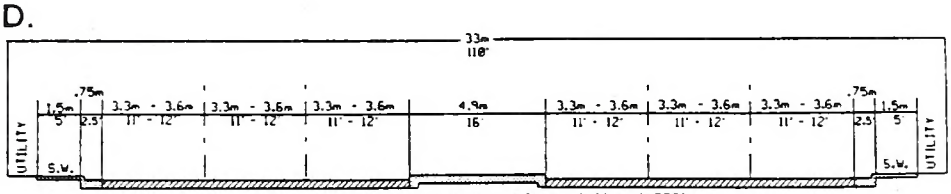
SEVEN LANES - CURB & GUTTER

C.



FIVE LANES - CURB & GUTTER

D.

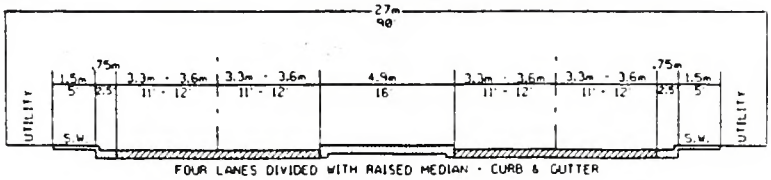


SIX LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

FIGURE C-1

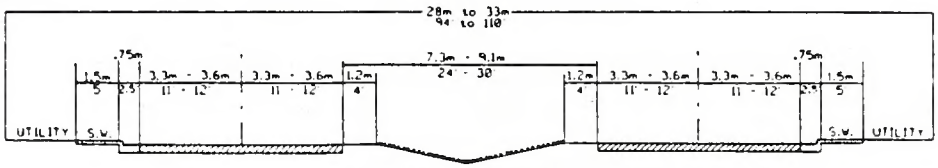
TYPICAL THOROUGHFARE CROSS SECTIONS

E.



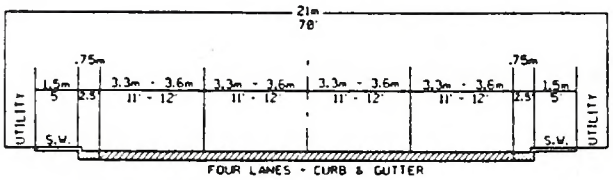
FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

F.



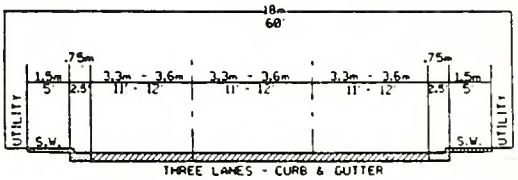
FOUR LANES DIVIDED - BOULEVARD
GRASS MEDIAN

G.



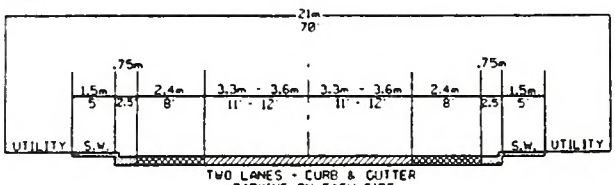
FOUR LANES - CURB & GUTTER

H.



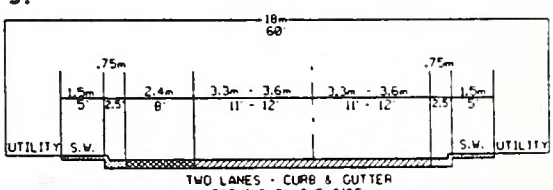
THREE LANES - CURB & GUTTER

I.



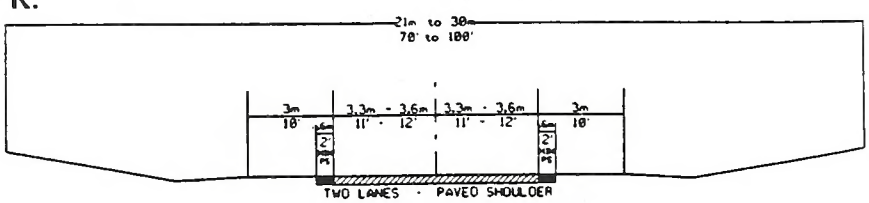
TWO LANES - CURB & GUTTER
PARKING ON EACH SIDE

J.



TWO LANES - CURB & GUTTER
PARKING ON ONE SIDE

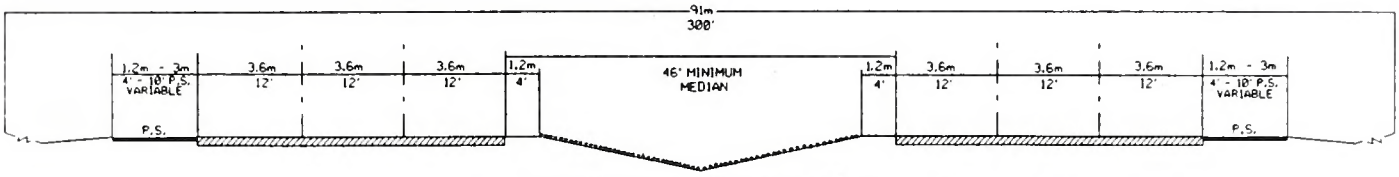
K.



TWO LANES - PAVED SHOULDER

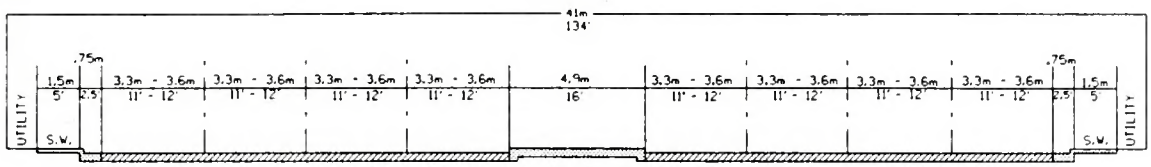
TYPICAL THOROUGHFARE CROSS SECTIONS

L.



SIX LANES DIVIDED WITH GRASS MEDIAN - FREEWAY

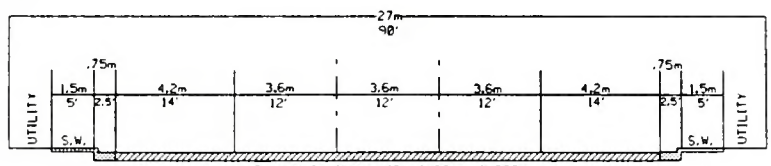
M.



EIGHT LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

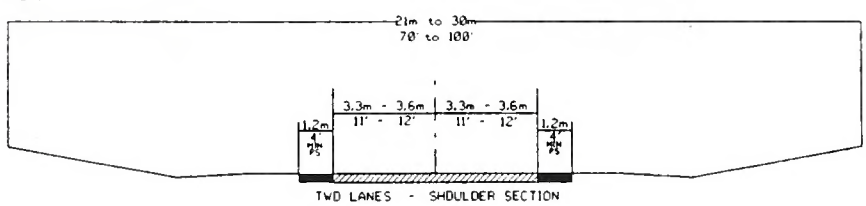
TYPICAL THOROUGHFARE CROSS SECTIONS FOR ACCOMMODATING BICYCLES

N.



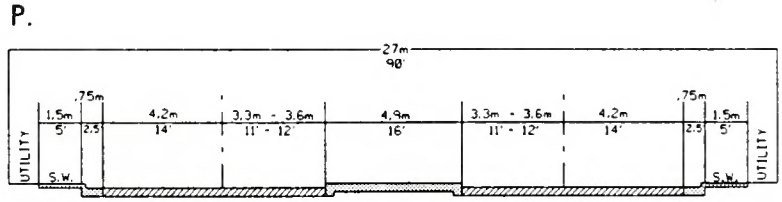
FIVE-LANE ROADWAY WITH CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES

O.



TWO LANES - SHOULDER SECTION

P.



FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES

Appendix D
Recommended Subdivision Ordinances

Definitions

Streets and Roads

Rural Roads

1. *Principal Arterial* - A rural link in a highway system serving travel, and having characteristics indicative of substantial statewide or interstate travel and existing solely to serve traffic. This network would consist of interstate routes and other routes designated as principal arterials.

2. *Minor Arterial* - A rural roadway joining cities and larger towns and providing intrastate and intercounty service at relatively high overall travel speeds with minimum interference to through movement.

3. *Major Collector* - A road which serves major intracounty travel corridors and traffic generators and provides access to the arterial system.

4. *Minor Collector* - A road which provides service to small local communities and traffic generators and provides access to the major collector system.

5. *Local Road* - A road which serves primarily to provide access to adjacent land, over relatively short distances.

Urban Streets

1. *Major Thoroughfares* - Major thoroughfares consist of interstate, other freeway, expressway, or parkway roads, and major streets that provide for the expeditious movement of high volumes of traffic within and through urban areas.

2. *Minor Thoroughfares* - Minor thoroughfares perform the function of collecting traffic from local access streets and carrying it to the major thoroughfare system. Minor thoroughfares may be used to supplement the major thoroughfare system by facilitating minor through traffic movements and may also serve abutting property.

3. *Local Street* - A local street is any street not on a higher order urban system and serves primarily to provide direct access to abutting land.

Specific Type Rural or Urban Streets

1. *Freeway, expressway, or parkway* - Divided multilane roadways designed to carry large volumes of traffic at high speeds. A *freeway* provides for continuous flow of vehicles with no direct access to abutting property and with access to selected crossroads only by way of interchanges. An *expressway* is a facility with full or partial control of access and generally

with grade separations at major intersections. A *parkway* is for non-commercial traffic, with full or partial control of access.

2. *Residential Collector Street* - A local street which serves as a connector street between local residential streets and the thoroughfare system. Residential collector streets typically collect traffic from 100 to 400 dwelling units.

3. *Local Residential Street* - Cul-de-sacs, loop streets less than 2500 feet in length, or streets less than 1.0 miles in length that do not connect thoroughfares, or serve major traffic generators, and do not collect traffic from more than 100 dwelling units.

4. *Cul-de-sac* - A short street having only one end open to traffic and the other end being permanently terminated and a vehicular turn-around provided.

5. *Frontage Road* - A road that is parallel to a partial or full access controlled facility and provides access to adjacent land.

6. *Alley* - A strip of land, owned publicly or privately, set aside primarily for vehicular service access to the back side of properties otherwise abutting on a street.

Property

1. Building Setback Line - A line parallel to the street in front of which no structure shall be erected.

2. Easement - A grant by the property owner for use by the public, a corporation, or person(s), of a strip of land for a specific purpose.

3. Lot - A portion of a subdivision, or any other parcel of land, which is intended as a unit for transfer of ownership or for development or both. The word "lot" includes the words "plat" and "parcel".

Subdivision

- Subdivider - Any person, firm, corporation or official agent thereof, who subdivides or develops any land deemed to be a subdivision.

- Subdivision - All divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, immediate or future, of sale or building development and all divisions of land involving the dedication of a new street or change in existing streets.

  The following shall not be included within this definition nor subject to these regulations:

  * the combination or re-combination of portions of previously platted lots where the total number of lots is not increased and the resultant lots are equal to or exceed the standards contained herein,
  * the division of land into parcels greater then 10 acres where no street right-of-way dedication is involved,
  * the public acquisition, by purchase, of strips of land for the widening or the opening of streets, and

* the division of a tract in single ownership whose entire area is no greater than 2 acres into not more than three lots, where no street right-of-way dedication is involved and where the resultant lots are equal to or exceed the standards contained herein.

- Dedication - A gift, by the owner, of his property to another party without any consideration being given for the transfer. The dedication is made by written instrument and is completed with an acceptance.

- Reservation - Reservation of land does not involve any transfer of property rights. It constitutes an obligation to keep property free from development for a stated period of time.

Roadway Design Standards

The design of all roads within a planning area shall be in accordance with the accepted policies of the North Carolina Department of Transportation, Division of Highways, as taken or modified from the American Association of State Highway & Transportation Officials' (AASHTO) manuals.

The provision of right-of-way for roads shall conform and meet the recommendations of the thoroughfare plan, as adopted by the municipality or county. The proposed street layout shall be coordinated with the existing street system of the surrounding area. Normally, the proposed streets should be the extension of existing streets if possible.

Right-of-Way Widths

Right-of-way (ROW) widths shall not be less than the following and shall apply except in those cases where ROW requirements have been specifically set out in the thoroughfare plan.

The subdivider will only be required to dedicate a maximum of 100 feet of ROW. In cases where over 100 feet of right-of-way is desired, the subdivider will be required only to reserve the amount in excess of 100 feet. In all cases in which ROW is sought for a fully controlled access facility, the subdivider will only be required to make a reservation. It is strongly recommended that subdivisions provide access to properties from internal streets, and that direct property access to major thoroughfares, principle and minor arterials, and major collectors be avoided. Direct property access to minor thoroughfares is also undesirable.

A partial width ROW, not less then 60 feet, may be dedicated when adjoining undeveloped property is owned or controlled by the subdivider. This is provided that the width of a partial dedication is such as to permit the installation of such facilities as may be necessary to serve abutting lots. When the said adjoining property is sub-divided, the remainder of the full required right-of-way shall be dedicated.

Table D-1

Minimum Right-of-way Requirements

Area Classification	Functional Classification	Minimum ROW
RURAL	Principle Arterial	Freeways- 350 ft Other- 200 ft
	Minor Arterial	100 ft
	Major Collector	100 ft
	Minor Collector	80 ft
	Local Road	60 ft[1]
URBAN	Major Thoroughfare	90 ft
	Minor Thoroughfare	70 ft
	Local Street	60 ft[1]
	Cul-de-sac	variable[2]

[1] The desirable minimum ROW is 60 ft. If curb and gutter is provided, 50 ft of ROW is adequate on local residential streets.

[2] The ROW dimension will depend on radius used for vehicular turn around. Distance from edge of pavement of turn around to ROW should not be less than distance from edge of pavement to ROW on street approaching turn around.

Street Widths

Widths for street and road classifications other than local shall be as recommended by the thoroughfare plan. Width of local roads and streets shall be as follows:

- ***Local Residential***
  - * Curb and Gutter section: 26 feet, face to face of curb
  - * Shoulder section: 20 feet to edge of pavement, 4 feet for shoulders

- ***Residential Collector***
  - * Curb and Gutter section: 34 feet, face to face of curb
  - * Shoulder section: 20 feet to edge of pavement, 6 feet for shoulders

Geometric Characteristics

The standards outlined below shall apply to all subdivision streets proposed for addition to the State Highway System or Municipal Street System. In cases where a subdivision is sought adjacent to a proposed thoroughfare corridor, the requirements of dedication and reservation discussed under the 'Right-of-Way Widths' section shall apply.

1. *Design Speed* - The design speed for a roadway should be a minimum of 5 mph greater than the posted speed limit. The design speeds for subdivision type streets are shown in Table D-2.

2. *Minimum Sight Distance* - In the interest of public safety, no less than the minimum sight distance applicable shall be provided. Vertical curves that connect each change in grade shall be provided and calculated using the parameters set forth in Table D-3.

3. *Superelevation* - Table D-4 shows the minimum radius and the related maximum superelevation for design speeds. The maximum rate of roadway superelevation (e) for rural roads with no curb and gutter is 0.08. The maximum rate of superelevation for urban streets with curb and gutter is 0.06, with 0.04 being desirable.

4. *Maximum and Minimum Grades* - The maximum grades in percent are shown in Table D-5. Minimum grade should not be less then 0.5%. Grades for 100 feet each way from intersections (measured from edge of pavement) should not exceed 5%.

Table D-2

Design Speeds

Facility Type	Design Speed (mph) Desirable	Minimum Level	Minimum Rolling
RURAL			
Minor Collector Roads (ADT Over 2000)	60	50	40
Local Roads[1] (ADT Over 400)	50	*50	*40
URBAN			
Major Thoroughfares[2]	60	50	40
Minor Thoroughfares	40	30	30
Local Streets	30	**30	**20

Note: *Based on ADT of 400-750. Where roads serve a limited area and small number of units, can reduce minimum design speed. **Based on projected ADT of 50-250. (Reference NCDOT Roadway Design Manual page 1-1B)

[1] Local Roads including Residential Collectors and Local Residential.

[2] Major Thoroughfares other than Freeways or Expressways.

Table D-3

Sight Distance

Design Speed (mph)	Stopping Sight Distance (feet)		Minimum K[1] Values (feet)		Passing Sight Distance (feet)
	Desirable	Minimum	Crest Curve	Sag Curve	For 2-lanes
30	200	200	30	40	1100
40	325	275	60	60	1500
50	475	400	110	90	1800
60	650	525	190	120	2100

Note: General practice calls for vertical curves to be multiples of 50 feet. Calculated lengths shall be rounded up in each case. (Reference NCDOT Roadway Design Manual page 1-12 T-1)

[1]K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length of the vertical curve, which will provide the desired sight distance. Sight distance provided for stopped vehicles at intersections should be in accordance with "A Policy on Geometric Design of Highways and Streets, 1990".

Table D-4

Superelevation

Design Speed (mph)	Minimum Radius of Maximum e[1]			Maximum Degree of Curve		
	e=0.04	e=0.06	e=0.08	e=0.04	e=0.06	e=0.08
30	302	273	260	19 00'	21 00'	22 45'
60	573	521	477	10 00'	11 15'	12 15'
80	955	955	819	6 00'	6 45'	7 30'
100	1,637	1,432	1,146	3 45'	4 15'	4 45'

[1] e = rate of roadway superelevation, foot per foot

Note: (Reference NCDOT Roadway Design Manual page 1-12 T-6 thru T-8)

Table D-5

Maximum Vertical Grade

Facility Type and Design Speed (mph)	Minimum Grade in Percent		
	Flat	Rolling	Mountainous
RURAL			
Minor Collector Roads*			
20	7	10	12
30	7	9	10
40	7	8	10
50	6	7	9
60	5	6	8
70	4	5	6
Local Roads*[1]			
20	-	11	16
30	7	10	14
40	7	9	12
50	6	8	10
60	5	6	-
URBAN			
Major Thoroughfares[2]			
30	8	9	11
40	7	8	10
50	6	7	9
60	5	6	8
Minor Thoroughfares*			
20	9	12	14
30	9	11	12
40	9	10	12
50	7	8	10
60	6	7	9
70	5	6	7
Local Streets*			
20	-	11	16
30	7	10	14
40	7	9	12
50	6	8	10
60	5	6	-

Note: *For streets and roads with projected annual average daily traffic less than 250 or short grades less than 500 ft long, grades may be 2% steeper than the values in the above table. (Reference NCDOT Roadway Metric Design Manual page 1-12 T-3)

[1] Local Roads including Residential Collectors and Local Residential.

[2] Major Thoroughfares other than Freeways or Expressways.

Intersections

1. Streets shall be laid out so as to interest as nearly as possible at right angles, and no street should intersect any other street at an angle less than sixty-five (65) degrees.

2. Property lines at intersections should be set so that the distance from the edge of pavement, of the street turnout, to the property line will be at least as great as the distance from the edge of pavement to the property line along the intersecting streets. This property line can be established as a radius or as a sight triangle. Greater offsets from the edge of pavement to the property lines will be required, if necessary, to provide sight distance for the stopped vehicle on the side street.

3. Offset intersections are to be avoided. Intersections that cannot be aligned should be separated by a minimum length of 200 feet between survey centerlines.

Cul-de-sacs

Cul-de-sacs shall not be more than 500 feet in length. The distance from the edge of pavement on the vehicular turn around to the right-of-way line should not be less than the distance from the edge of pavement to right-of-way line on the street approaching the turn around. Cul-de-sacs should not be used to avoid connection with an existing street or to avoid the extension of an important street.

Alleys

1. Alleys shall be required to serve lots used for commercial and industrial purposes except that this requirement may be waived where other definite and assured provisions are mode for service access. Alleys shall not be provided in residential subdivisions unless necessitated by unusual circumstances.

2. The width of an alley shall be at least 20 feet.

3. Dead-end alleys shall be avoided where possible, but if unavoidable, shall be provided with adequate turn around as may be required by the planning board.

Permits for Connection to State Roads

An approved permit is required for connection to any existing state system road. This permit is required prior to any construction on the street or road. The application is available at the office of the District Engineer of the Division of Highways.

Offsets To Utility Poles

Poles for overhead utilities should be located clear of roadway shoulders, preferably a minimum of at least 30 feet form the edge of pavement. On streets with curb and gutter, utility poles shall be set back a minimum distance of 6 feet from the face of curb.

Wheel Chair Ramps

All street curbs being constructed or reconstructed for maintenance purposes, traffic operations, repairs, correction of utilities, or altered for any reason, shall provide wheelchair ramps for the physically handicapped at intersections where both curb and gutter and sidewalks are provided and at other major points of pedestrian flow.

Horizontal Width on Bridge Deck

The clear roadway widths for new and reconstructed bridges serving two-lane, two-way traffic should be as follows:

- shoulder section approach:
    * under 800 ADT design year - minimum 28 feet width face to face of parapets, rails, or pavement width plus 10 feet, whichever is greater,
    * 800 - 2000 ADT design year - minimum 34 feet width face to face of parapets, rails, or pavement width plus 12 feet, whichever is greater,
    * over 2000 ADT design year - minimum width of 40 feet, desirable width of 44 feet width face to face of parapets or rails;
- curb and gutter approach:
    * under 800 ADT design year - minimum 24 feet face to face of curbs,
    * over 800 ADT design year - width of approach pavement measured face to face of curbs,
    * where curb and gutter sections are used on roadway approaches, curbs on bridges shall match the curbs on approaches in height, in width of face to face curbs, and in crown drop; the distance from face of curb to face of parapet or rail shall be a minimum of 1.5 feet, or greater if sidewalks are required.

The clear roadway widths for new and reconstructed bridges having 4 or more lanes serving undivided two-way traffic should be as follows:

- shoulder section approach - width of approach pavement plus width of usable shoulders on the approach left and right. (shoulder width 8 feet minimum, 10 feet desirable)
- curb and gutter approach - width of approach pavement measured face to face of curbs.

Appendix E
Resources and Contacts

North Carolina Department of Transportation

Customer Service Office
1-877-DOT4YOU
(1-877-368-4968)

Secretary of Transportation
1501 Mail Service Center
Raleigh, NC 27699-1501
(919)733-2520

Board of Transportation Member
Current contact information for the Board of Transportation may be accessed from the NCDOT homepage (http://www.dot.state.nc.us/board)
Or by calling the Customer Service Office.

Highway Division
Division specific contact information can be found at
http://apps01.dot.state.nc.us/apps/directory/toc.html

Division Engineer
Contact the Division Engineer with general questions concerning NCDOT activities within each Division; information on Small Urban Funds.

Division Construction Engineer
Contact the Division Construction Engineer for information concerning major roadway improvements under construction.

Division Traffic Engineer
Contact the Division Traffic Engineer for information concerning high- collision locations.

District Engineer
Contact the District Engineer for information regarding Driveway Permits, Right of Way, Encroachments, and Development Reviews.

County Maintenance Engineer

Contact the County Maintenance Engineer regarding any maintenance activities, such as drainage.

Centralized Personnel

Statewide Planning Branch

Contact the Statewide Planning Branch with long-range planning questions.
1554 Mail Service Center
Raleigh, NC 27699-1554
(919) 733-4705

Secondary Roads Office

Contact the Secondary Roads Office for information regarding the Industrial Access Funds Program.
P.O. Box 25201
Raleigh, NC 27699
(919) 733-2039

Program Development Branch

Contact the Program Development Branch for information concerning Roadway Official Corridor Maps and the Transportation Improvement Program (TIP)
1534 Mail Service Center
Raleigh, NC 27699-1534
(919)733-2039

Project Development & Environmental Branch

Contact PDEA for information on environmental studies for projects that are included in the TIP.
1548 Mail Service Center
Raleigh, NC 27699-1548
(919) 733-3141

Highway Design Branch

Contact the Highway Design Branch for information regarding alignment for projects that are included in the TIP.
1584 Mail Service Center
Raleigh, NC 27699-1584
(919) 250-4001

Public Transportation Division

Contact the Public Transportation Division for information public transit systems.
1550 Mail Service Center
Raleigh, NC 27699-1550
(919) 733-4713

Other Departments

Contact information for other departments within the NCDOT not listed here are available at the NCDOT homepage at http://apps01.dot.state.nc.us/apps/directory/toc.html or by calling the Customer Service Office.

Other State Government Offices

Division of Community Assistance

Contact the Division of Community Assistance for information regarding the Community Planning Program. You may find their contact information at *http://www.dca.commerce.state.nc.us*

Appendix F
Transportation Improvement Program
Project Request Process

The process for requesting projects to be included in the Transportation Improvement Program (TIP) is described briefly in this appendix.

The local representatives should first decide which projects from the thoroughfare plan they would like funded in the TIP. A TIP request for a few carefully selected projects is likely to be more effective than requesting all the projects proposed in the thoroughfare plan. These projects should be prioritized by the local representatives and summarized briefly, as shown on Appendix Page F-3.

After determining which projects are the highest priority for the area, a TIP project request should be sent to the Board of Transportation Member from the municipality's or county's respective district. The TIP project request should include a letter with a prioritized summary of requested projects, as well as a TIP candidate project request form and a project location map for each project. An example of each of these items is included in this appendix.

Example

* *Note: This is not an official request submitted to the Board of Transportation. This is intended to be an example of a Transportation Improvement Program (TIP) Request.*

Month ##, Year

North Carolina Board Member
N. C. Board of Transportation
N. C. Department of Transportation
P. O. Box 25201
Raleigh, NC 27611-5201

Dear Board Member:

SUBJECT: 2002-2008 TIP Project Requests for *Generic* County

Enclosed find the projects requested by *Generic* County for consideration in the next TIP update. The list is presented by priority, as approved by the *Generic* County Commissioners at their *Month* meeting.

Generic County also endorsed the existing schedule of projects contained in the current TIP for the county, with one request. The county requests that TIP Project R-*XXXX* remain as a high priority and kept on the existing schedule.

We thank you for the opportunity to participate in development of the State TIP. Please contact us immediately if additional information is needed concerning any of the enclosed project requests.

Sincerely,

John Q. Public

cc: Division Engineer
Enclosure

Generic County
County Commissioners
2002 Proposed Highway Projects (Final)

1) **SR 1111 (Town Street) & SR 1112 (Industry Drive) TIP Project R-XXXX**
   - From SR 1113 (Country Road) to NC 11
   - Widen roadway to a multilane facility, with some new location

2) **US 11**
   - From SR 1112 (Industry Drive) to SR 1113 (Country Road)
   - Widen roadway to a multilane facility

3) **NC 11**
   - From SR 1114 (Any Road) to the existing four lane section just south of I-85
   - Widen roadway to a multilane facility

4) **US 11 Business (Business Road)**
   - From SR 1115 (Some Road) to NC 12
   - Widen facility to a five lane cross section

5) **New Connector**
   - From US 11 to US 112 Business (City Street)
   - New Facility

Highway Program
TIP Candidate Project Request

(Please Provide Information if Available)

Date *##/##/##* Priority No. *#*

County *Generic* City/Town _____

Requesting Agency *County Commissioners* NCTIP No. *R-####* (if available)

Route (US, NC, SR/Local Name) *SR 1111(Town Street) and SR 1112(Industry Drive)*

Project Location (From/To/Length) *From SR 1113 (Country Road) to NC 11, #.# miles*

Type of Project (Widening, New Facility, Bridge Replacement, Signing, Safety, Rail Crossing, Bicycle, Enhancement, etc.)
Widen roadway to a multi-lane facility, with some new location.

Existing Cross Section *24* Feet, Type _____

Existing Row *60 to 80* Feet Existing ADT *8,000 (1996)*

Estimated Cost, ROW $ *900,000* Construction $ *4,000,000*

Brief Justification for Project *As a major thoroughfare, this facility carries increasing traffic volumes between the industial sites along this route to NC 11 and the I-85 corridor. In the adopted thoroughfare plan for Generic County, it is recommended that this facility should be widen to a multi-lane cross section due to the increasing volume and the potential for more development in this area. The county requests that this project continue to be funded.*

Project Supported By (Agency/Group) _____

Other Information/ Justification

- ☒ Part of Thoroughfare Plan
- ☐ Part of Comprehensive Plan
- ☐ Serves School
- ☐ Serves Hospital
- ☐ Obsolete Facility
- ☐ Serves Park
- ☐ High Accident (#)
- ☐ _____

(Please Attach Map Showing Project Location)

Appendix G
Future Year Recommendation

This section includes the purpose and need for a recommendation that was presented to the Watauga County Planning Board and County Commissioners. The recommendation was met with great opposition, specifically from the citizens of the Valle Crucis community. The County agreed to have the recommendation placed in the Appendix in order that recommendation could be reevaluated in the next Thoroughfare Plan update.

SR 1112 (Broadstone Road)- Purpose and Need

- **Project Recommendation:** It is recommended that SR 1112 (Broadstone Road), be widened to a three-lane facility from NC 194 to NC 105, for a total length of 2.8 miles.

- **Transportation Demand:** The route is functionally classified as a minor collector, which primarily provide service to smaller communities and link rural areas to the local important traffic generators.

- **Roadway Capacity and Deficiencies:** The current average daily traffic on Broadstone Road is 5,000 vehicles per day (vpd). The capacity of the existing roadway is 7,000 vpd. The projected average daily traffic of 10,000 will result in the facility being over capacity by the year 2030. The route is currently operating at level of service (LOS) D and, without any improvements, will worsen to a LOS F by the year 2030, based on traffic growth projections. The proposed cross section, a three-lane facility, will provide capacity of 13,500.

- **Safety Issues:** If no improvements are made to SR 1112, increasing traffic congestion will result in the potential for increased accident rates. However, the recommended improvements to the facility will provide increased capacity, greater maneuverability, and more control of access, resulting in safer driving conditions.

- **Social Demands and Economic Development:** The economy of Watauga County has shifted from agriculture to a combination of manufacturing, retail, education, and tourism. An economic boost to Watauga has come from the development of recreational and tourist facilities. The recommended improvements to SR 1112, in addition to accommodating the expected traffic increase, may also help spur further economic development in this area. Economic development in any portion of the county will increase the tax base, which can be used to improve public services throughout the county, thereby inducing other industries to locate in the county.

- **System Linkage:** SR 1112 is functionally classified as a minor collector. Broadstone Road collects traffic from local roads and feeds the traffic onto NC 105, a principal arterial and onto NC 194, a major collector. It is therefore important that the highway is kept in good operating condition.

- **Relationship to Other Plans:** This project is not directly connected to any other thoroughfare plans.